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THE

PHILOSOPHY OF MEDICINE.

C. R. Ryley Delt. J. Caldwall Sculp.t

OMNIA METIT TEMPUS

THE

Philosophy of Medicine:

BEING

MEDICAL EXTRACTS,

ON THE

NATURE AND PRESERVATION

OF

HEALTH,

AND

ON THE NATURE AND REMOVAL OF DISEASE.

BY

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TO

THE MOST NOBLE

EARL OF LONSDALE,

VISCOUNT LOWTHER,

LORD LIEUTENANT OF THE COUNTIES OF CUMBERBERLAND, WESTMORLAND, & NORTHUMBERLAND,

&c. &c. &c.

MY LORD,

IT affords me the highest satisfaction to have lived at a period when all the sciences have made the most rapid advances; and that of Medicine, the most interesting and useful pursuit, has kept an equal pace with her sister arts; and at a time when your Lordship flourishes the distinguished Patron of all those arts and sciences which adorn and ameliorate the condition of mankind; and in declaring how much Great Britain owes in this respect to the fostering influence of your Lordship's high birth, exalted mind, and great benevolence of heart, whereby science becomes expanded in its bud, afterwards flourishes like a fair plant by the water's side, puts forth abundant leaves, blossoms, and fruit: and that your Lordship may long live the Patron of the arts and sciences, and receive the heart-felt plaudits of universal esteem, is the sincere prayer of him who has now the honour of thus publicly expressing his admiration of your Lordship's exalted character, and I have the honour to remain,

My Lord,

With unfeigned respect and gratitude,
Your Lordship's most obliged,
Devoted servant,

R. J. THORNTON, M.D.

London, March 20, 1813.

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THE
PROGRESS
OF
Chemistry.

Increscunt quotannis Scientiæ, emendantur quotidie, et ad fastigium suum optatum sensim sensimque, plurium virorum opera et studiu junctis, feliciter properant. Thunberg.

SECTION I.

CHEMISTRY is defined by Suidas to be the preparation of silver and gold. The word κατασκευὴ seems to imply no more than the separation of silver and gold from their ores. Suidas adds, that the Emperor Dioclesian ordered all the books he could procure, which treated on these subjects, to be burnt; lest the *Egyptians* should by this art grow rich, and be tempted to rebel.

It should, at first appearance, seem strange, that a flat country, like that of *Egypt*, which was never remarkable for having either gold or silver mines, should be celebrated for the skill of its inhabitants, with respect to the treatment of metals. But, if we consider the prodigious riches of ancient Egypt, we may, perhaps, find reason to suspect, that it had, however, some other source of wealth than the fertility of the soil. It is not improbable, that the ancient Egyptians carried on a commerce into the inland parts of Africa, where gold ore, or gold dust, was found, and perhaps silver; which traffic, for political reasons, they might conceal from other nations. As the priests ingrossed all the learning, as well as wealth, of the country, they were therefore the smelters and refiners of these ores; and the method of treating them they would probably keep to themselves, both for national and private considerations. Hence, if they wrote upon the subject, whatever they delivered was so involved in allegory, and designedly obscured, that nobody but their own order could find out the meaning. It is even probable, that they pretended to the art of converting baser metals, which they used in their processes, into real gold, the better to conceal the true sources of their wealth. Now when men of learning, in after ages, met with their books, not being able to understand their true meaning, and not knowing how to decypher them, they might take their allegories in a literal sense, and thus believe, that there really was a method of making gold from other metals. When such a notion, foolish as it was, had once begun to prevail, it was natural enough for the avarice of mankind to leave nothing untried for the revival of so beneficial an art, supposed to be lost. This mistake was, probably, the foundation for all those researches which have been made after the transmutation of metals; for I can never believe, that there ever was, in reality, any such art; the converting of one metal into another, being in my apprehension, attended with as much difficulty as the converting a stone into a diamond. The mistake was, however, very fortunate for chemistry; because the experiments made on this account gave occasion to the developement of many important chemical discoveries.

The priests, in order to support their reputation, wrote books on their pretended science, and had the art of expressing the subject in a mysterious and learned jargon. Several of these obscure writers seem sensible of the reproach, and they promise to speak plain and intelligibly; but instead of revealing, they even express their hidden secrets more obscurely than any of their predecessors.

Afterwards chemistry was seized on as a source of wealth by princes, and it went from priests, into the hands of common miners, and smelters of metals, men unacquainted with the liberal sciences, debarred from all commerce with the learned world, condemned to lead their lives in darkness under ground, and to support their wretched beings with coarse and hard fare. Consider these men daily obnoxious to a thousand dangers, dreading what may happen, disturbed in mind, and leading a very uneasy life, trembling at the frequent earthquakes, the rapid torrents from the mountains, at the meteors and damps, the coruscations of the gross and sulphurous exhalations, the resoundings of the caverns, and the subterraneous bellowings. Under all this, having no wise or prudent person to consult, who might remove their vain fears, and restore light to their troubled minds: hence they gave their attention to superstitious tales, and fabulous stories, calculated to frighten as well as amuse, and, by increasing melancholy, from fools became madmen. Hence was seriously taught as part of chemistry the belief of sorceries, fascinations, inchantments, prognostics, the use of amulets, genii confined in seals, wands, rings, allegories, emblems, types, riddles; and a little truth was so blended with a large farrago of falsehood, that the real science of chemistry became invisible, and nearly obliterated.

The boasted pretensions of the early alchemists and chemists, could not escape the just censure of Roger Bacon, an Englishman, who, in the thirteenth century, like a bright star in a dark hemisphere, shone forth the glory of his country. This extraordinary person knew so well how to reduce the powers of Nature within the rules of art, as, by their combination, to perform things which far surpassed the pretended miracles of the magicians. He demonstrated, by experiments, that human industry, with an insight into nature, can produce effects, which they, with all their charms, sorceries, and invocation of demons, are unable to imitate. He very easily, and with admirable ingenuity, exposes the monstruous and hurtful superstitions, deliriums, and enthusiasms of the times in which he lived. He very judiciously and religiously distinguishes between the sacred mysteries of piety, and the ridiculous chimæras and inventions of an unsettled brain; between the corruptible principles of the body, and the celestial origin of the soul; between Nature and God. He points out with equal sagacity and truth, the folly of the blind superstition of his contemporaries.— "Admiration," says he, "the parent of magic, is the offspring "of ignorance, begot by a vitiated imagination. When "weak and ignorant minds perceive an effect, whose cause "is hid far in the dark, they presently have recourse to "something supernatural to solve the difficulty, and fancy "it the production of some magical power." He adds, "there is no such thing really as magic, unless by that "word be meant a knowledge of the properties of bodies, "and the methods of Nature, by an observance and application of which many things, even much more surprising "than magic, can be effected."

Nevertheless Francis Bacon was accused and found guilty of having dealings with the devil, was excommunicated by the pope, and for ten years kept in close confinement.

By an attentive perusal of his works, the reader will be astonished to find, that this great luminary, at so distant a period as the thirteenth century, understood not only chemistry, and really was the inventor of gunpowder*, and phosphorus, but that he also was acquainted with the use and art of making convex and concave glasses, the camera obscura, burning glasses, telescopes, and contrived something like an air pump; and he mentions himself, "that "in the space of twenty years study of Nature, in the pur-"chase of instruments, and scarce books, he spent upwards "of two thousand pounds;" a vast sum in those days. His writings are equally elegant and nervous.

We will not tire the reader with tracing the progress of chemistry through the dark and fabulous ages of chemistry; but commence at that time when alchemists gave up their golden dreams, and turned their attention to improve by this art the science of medicine.

To point out in historical order the manner in which the truths of the science have been applied to the arts of life, or the benefits derived by society from them, would occupy many volumes. From the first discovery of the production of metals from rude ores, to the knowledge of the bleaching liquor, chemistry has been continually subservient to cultivation and improvement. In the manufacture of porcelain and glass, in the arts of dyeing and tanning, it has added to the elegancies, refinement, and comforts of life; in its application to medicine it has removed the most formidable diseases; and in leading to the discovery of gunpowder, it has changed the institutions of society, and rendered war more independent of brutal strength, less personal, and less barbarous.

Basil Valentine seems to have been the first who employed *antimony*. He was a Benedictine monk, and

---

[*] Speaking of this discovery, Friar Bacon says, if you mix sulphur and nitre with a third substance, which I will not name, from the dangerous uses it may be put to, an explosive powder may be formed, &c.

flourished about the fifteenth century. It is reported of him, that having thrown away some antimony, he noticed the swine, who accidentally had eaten it, purged greatly, and, to his no great astonishment afterwards grew extremely fat. He began immediately to employ it as a medicine, and shortly after published his "Currus Triumphalis Antimonii" (the Triumphal Car of Antimony), where he highly extols the virtues of this mineral, and its preparations, for the cure of an infinite number of diseases. This remedy, however, was looked upon, even in his time, as an highly pernicious poison, and Jacob Grevinus published a treatise against it, in which he advises the magistrates to prohibit its sale, as they had done that of quicksilver and orpiment.

The doctrines of Galen, which were spread over Europe, had taken such firm root in the 16th century, that they seemed to defy all opposition. The remedies invented by chemical operations were at that time only administered by men in the lowest condition of life, men without science, without industry, and without honour. At length, however, PARACELSUS appeared. He does not seem to have studied physic in any of the established schools; but while he travelled in different countries he picked up remedies from all sorts of people, and particularly from the chemists of those days. From these he learned the use of mercury and antimony, and from some hardy empirics the use of opium. When returning home from his travels he determined upon following his father's profession, which was that of physic, and by these remedies he was able to cure many diseases that baffled the inert remedies of the Galenists; and being of a bold and boastful disposition, he made the most of these cures; while, at the same time, the partiality of mankind to novelty soon contributed to give him fame. He was so far more fortunate than other chemical practitioners that he obtained the professor's chair at the university of Basil. In this new situation he attempted a system of physic, blended with the most extravagant and visionary doctrines, supported and covered by a great deal of new and unmeaning jargon of his own. His lectures were chiefly employed in recommending his own chemical remedies, and declaiming in the most outrageous manner against the regular practitioners. He went even so far as publicly to burn the works of the Greek physicians; and he insolently told the physicians of Basil, that the very down of his bald pate had more knowledge than all their writers, the buckles of his shoes more learning than Galen or Avicenna, and his beard more sense than all the universities together.

He not only taught the pretended and imaginary agreement betwixt the principal parts of man's body with the planets; as of the heart with the Sun, of the brain with the Moon, of the spleen with Saturn, of the lungs with Mercury, the kidneys with Venus, the liver with Jupiter, and the gall with Mars; and the agreement of the seven metals to disorders of these parts as they agree with the seven planets, the power of vigils, incantations, &c. but also added to these absurdities animal magnetism, using the hand, a doctrine which has made so much noise in our own time. He also had a panacea against all disorders, and boasted that he possessed drugs that could prolong life to any period.

It seldom happens that a man of but common abilities, and in the most retired scenes of life, observes such a strict uniformity of conduct, as not to afford prejudice and partiality sufficient materials for drawing his character in different colours; but such a great and irregular genius as Paracelsus could not fail of becoming alike the subject of extremes of panegyric and of satire. He has accordingly been esteemed by some a second Æsculapius; and others have thought that he was possessed of more impudence than merit, and that his being spoken of, was more owing to the brutal singularity of his conduct, than to the cures he performed.

But in whatever estimation the merit of Paracelsus as a Chemist or physician be held, certain it is that he formed a sect of practitioners, who appeared in opposition to the established schools, which were then entirely followers of Galen, and these two adverse parties agitated Europe for more than five hundred years.

The enthusiasm of this man, says Professor Davy, almost supplied his want of genius. He formed a number of new preparations of the metals, which were studied and applied by his disciples; his exaggerated censure of the methods of the ancients, and of the systems of his day, had an effect in diminishing their popularity; one error was expelled by another; and it is a great step towards improvement, that men should know they have been in delusion.

VAN HELMONT flourished about ninety years after Paracelsus. He was born of a noble family at Brussels in 1588, and medicine in those days being a profession beneath his rank in life, he gave up his paternal inheritance to his family, and left his country in order to pursue the bent of his genius. Haying conceived a violent prejudice against the *Galenical methods* from his own ill success in putting them into practice, and finding *chemistry* productive of so many, and such powerful medicines, he ran counter in every thing to the *Galenic doctrines*, and endeavoured to reduce the whole practice of physic to the principles of chemistry. In the year 1609 he married a very rich lady, after which he gave himself up wholly to chemistry; and although he did not visit any one out, so great was his reputation, and not practising for gain, that he cured, as he assures us, every year, some thousands of sick people. He employed fifty years of his life in assiduously examining the fossil, animal, and vegetable kingdoms.

His skill was so great, and the phænomena his chemistry presented so marvellous, that he was accounted a magician, and thrown into the inquisition: and having with difficulty extricated himself from this abominable charge, he was released, and retired to Holland.

He first gave the name of *gas* to those vapours, which resemble the air we breathe. He observed, "'that some "bodies resolve themselves almost entirely into this aeri-"form substance. Not," adds he, "that they are contained "in this shape in those bodies from which they are sepa-"rated; but exist in them in a concrete form, as if fixed "or coagulated. He asserts, that 62 pounds of charcoal "contain 61 pounds of gas, and only one pound of earth." The gas which flies off from calcareous earths and metallic bodies, while they effervesce in acids, did not escape his notice: "the quantity contained in tartar is so great, that "it breaks and bursts into shivers the vessels in which it "is distilled, if a free egress be not given to it." He applied this theory to the explanation of some phænomena of the animal economy. It is to this effluvium that Van Helmont attributes the fatal effects of the Grotto Del Cani;—the suffocation of workmen in mines;—the accidents occasioned by the vapour of charcoal;—and that deleterious atmosphere which is breathed in cellars, where spirituous liquors are in fermentation. He accounts for several diseases upon this principle, and ascribes the propagation of epidemical disorders to noxious vapours with which the air is sometimes infected.

Van Helmont undoubtedly would have made a still greater figure in the world had he forborne running into the notions of Paracelsus, and given less into the superstitions of the times. His reputation has also suffered from his posthumous works. As he perceived his end approaching, he called for his son, and gave him the following charge. "Take all my writings, the crude as well as finished ones, "and join them together, and publish them; for so it hath "pleased Almighty God, who directs all things for the "best." And the son, who in his early youth had ran away from his father to stroll with gipsies, after the father's decease, literally jumbled all the papers together, which had been framing for fifty years, and then left the impression wholly to the printer without the smallest correction.

Professor Davy, speaking of Van Helmont, says, that he was formed in the school of Alchemy, and his mind was tinctured with its prejudices; but his views concerning nature and the elements were distinguished by much more philosophical acuteness, and more sagacity, than those of any former writer.

Nothing but success could shake off the torpor or vanquish the bigotry of the Galenists. These at last finding their throne totter, called in the aid of the secular power, and employed it to crush their adversaries. In France antimony was prohibited; but in Germany the chemists prevailed, and the Galenists were obliged sometimes to have recourse to the remedies of the chemists, when SENNERTUS, one of the most eminent of the Galenists in Germany, endeavoured to reconcile the two opposing parties.

Very early in the seventeenth century, Sir THEODORE MAYERNE, who as a chemical physician had been much opposed and oppressed by the Galenists of France, was called over into England, where he was appointed first physician to the king, and continued to hold that office for more than thirty years. His theory and his prescriptions were like those of the Galenists; but he was at the same time a great favourer of chemical medicines, and particularly of antimony; the medicine, with regard to which the two sects were more especially divided. It does not however appear, that he met with any violent opposition from the physicians in England: but, on the contrary, we find him becoming a member of, and acquiring great authority in, the London college. It is probable that his great credit put an end in England to all distinction between the Galenic and chemical practitioners; and, as in the year 1666, the faculty of Paris rescinded their arret forbidding the use of antimony, the odious distinction between the Galenists and chemists gradually diminished.

At this period flourished that universal genius, Lord Chancellor BACON, who happily describes "the Alchemists to resemble those husbandmen who in searching for a treasure supposed to be hidden in their land, by turning up and pulverising the soil, rendered it fertile; in seeking for brilliant impossibilities, they sometimes discovered useful realities;" and in speaking of the chemistry of his time, he says, "a new philosophy has arisen from the furnaces, which has confounded all the reasonings of the ancients." This illustrious man himself pointed out many important objects of chemical enquiry; but he was a still greater benefactor to the science, by his developement of the general system for improving natural knowledge. Till his time there had been no distinct views concerning the art of experiment and observation. Lord Bacon demonstrated how little could be effected by the unassisted human powers, and the weakness of the strongest intellect even without artificial resources. He directed the attention of inquirers to instruments for assisting the senses, and for examining bodies under new relations. He taught that man was but the servant and interpreter of Nature; capable of discovering truth in no other way but by observing and imitating her operations: the facts were to be collected and not speculations formed: and that the materials for the foundations of true systems of knowledge were to be discovered, not in the books of the ancients, not in metaphysical theories, not in the fancies of men, but in the visible and tangible external world.

In his comprehensive view of things, he felt that chemistry might turn out one of the most curious and useful branches of natural philosophy. He advised the collecting of facts, and to compare these very maturely and cautiously, in order to discover, if possible, the causes and circumstances upon which they depend, and declares that in this way only could any satisfactory system be produced.—*Theories*, he thought, were only useful so far as they arose from *experiments* already made, or as they might lead to new ones: for *reasoning* may be considered as the eye of the philosopher; but *experience* is his feeling; and this latter sense ought constantly to rectify the too frequent errors of the former. " If *experiments*, undirected by theory, are " only a blind feeling; *theory*, without experiments, is a " deceitful and uncertain vision."—It was thus that this sagacious philosopher directed men in the true path of science, and banished for ever that dark and abstruse philosophy, which was built upon the absurdest conjectures.

I shall not presume to decide which of the two great branches of natural philosophy contributes most to the use and the ornament of life; but I think it natural that the mechanical department, where palpable masses of matter are brought into action, and motion is visible in its progress, should sooner advance towards perfection than the chemical, where effects are produced by the insensible movements of imperceptible particles. " It seems therefore to have its foundation in the order of things," says Dr. Beddoes, " that the philosophers of the preceding age should have been employed chiefly by astronomers and mechanics, and those of the present by *chemistry*." Yet if the rule be at all just, what a violent exception,—suffer me to repeat it,—have we in the instance of our own countryman, Dr. Hook, who silently, and unperceived, discovered, if not the whole sum and substance, yet certainly many of those splendid facts which adorn the writings of Priestley, Cavendish, Scheele, Lavoisier, and other philosophers of the present day.

" From the experiment of charring of wood," (which is done by putting it into a crucible, pot, or any other vessel that will endure to be made red-hot in the fire without breaking, and then covering it over with sand, so as to prevent the access of air, and continuing it in a strong heat for an hour or more, according to the size of the body to be charred), " seeing that, notwithstanding the great heat, " and the duration of it, the solid parts of the wood remain " undissipated whilst they are preserved from the free ac" cess of air, we may learn," says he, " *what has not, that I* " *know of, been published or printed, nay, not so much as* " *thought of by any*; and that, in short, is this :

1st. " That the *air* in which we live, move, and breathe, " that this air is the menstruum, or universal dissolvent " of all inflammable bodies.

2d. " That this action it performs not until the body be " first sufficiently heated.

3d. " That this action of dissolution produces or gene" rates a very great *heat*, or what we call fire.

4th. " That from this action *light* is also produced.

5th. " That these phænomena do not arise from the air " itself considered as an element, but from *that part* of the " air which is inherent in it, and is *like*, if not the *very* " *same*, as *that* which is *fixed* in *salt-petre*, which may, I " think, most evidently be demonstrated by a multitude " of experiments made by salt-petre.

6th. "That by this dissolution the inflammable body "mixing with the nitro-aerial part of the air, becomes a "new kind of air, just as metalline or other bodies, dissolved in any menstruum, does the motions and progress "of that menstruum, until it be precipitated.

"This *theory* of mine," he continues, "does so exactly "agree with all the phænomena of fire, and so genuinely "explicates each particular circumstance, as the production of *heat* and *light*, and the *disappearance* of the *burning body*, that it is more than probable that this cause "which I have assigned is the true, adequate, real, and "only cause of those phænomena. As the idea is *entirely* "*new*, I will proceed a little further.

7th. "The dissolving part of the air is but a small part "of the whole air, and resembles those acid menstruums "containing other parts besides the acidifying principle, "therefore they are soon glutted and can dissolve no more; "and therefore unless some fresh part of the menstruum "be applied to the body to be dissolved, the action ceases, "and the body ceases to be dissolved; saltpetre, on the "other hand, being replete with these dissolving particles, "hence the dissolution of inflammable bodies will be very "quick and violent, therefore it is observable, that, as in "other solutions, if a copious and quick supply of fresh "menstruum, though but weak, be poured on, or applied "to the dissoluble body, it quickly consumes it; so this "menstruum of air, if by bellows, or any other such contrivance, it be copiously applied to the shining body, is "found to dissolve it as soon as the menstruum of burning nitre."

"This theory of *mine*," he again repeats it, "of the "action of air, and of that particular part, which I would "call nitro-aerial, I have endeavoured to raise from an "infinite number of observations and experiments, the

" process of which would be too long to be here inserted, " (he means in his Micrographia, published in 1664), and " will perhaps another time afford matter copious enough " for a much larger discourse, the air being a subject " which, (though all the world has hitherto lived and " breathed in, and has yet been so little truly examined " or explained, that a diligent enquirer will be able to find " but very little information from what has been written " of it: but being once well understood, it will, I doubt " not, enable a man to render an intelligible, nay probable, " if not the true reason of all the phænomena of fire, which, " as it has been found by writers and philosophers of all " ages, is a matter of no small difficulty, as may be sufficiently understood by their strange hypotheses, and " unintelligible solutions of some few phænomena of it; " so will it prove a matter of no small concern and use in " human affairs, as I shall elsewhere endeavour to manifest " when I come to shew the use of air in respiration, and " for the preservation of the life, nay for the conservation " and restauration of health, as also its uses in chemical, " mechanical, and other operations. In this place it becomes me only to hint an hypothesis, which, if God permit me life and opportunity, I may elsewhere prosecute, " improve, and publish."

Hook, here, reasons perfectly correct, and we see him afterwards laying open the thorax of a dog, cutting away his ribs and diaphragm, and taking off the pericardium, and in that state keeping him alive before the Royal Society, by blowing fresh air into his lungs. " It was observed," he remarks, " that as often as we left off blowing, and suffered the lungs to subside and lie still, the heart ceased " to beat, the animal became convulsed, but he soon recovered again by renewing the blast."

" To prove that the motion of the lungs in breathing was no otherwise necessary to the life of the animal, than as by this motion the lungs receive a constant supply of fresh air, he next pricked all the outer coat of the lungs with the slender point of a sharp penknife, and by a constant blast made by a double pair of bellows, he kept the lungs always distended, supplying the air as fast as it escaped by these apertures, and it was observed that while the blast from the bellows was kept up, the blood flowing from the punctures in the substance of the lungs was of a bright florid colour, that the dog lay still, his eyes were quick, and his heart beat regularly; but that upon leaving off blowing, the blood issuing from the punctures in the lungs was of a dark colour like venal blood, the heart ceased to act, the eyes appeared sunk, and the dog fell into convulsive motion, and he as soon recovered again on renewing the blast, and supplying the lungs with air." It would be foreign to this work to enter more fully into the discoveries of Hook. I can only here express my astonishment, that doctrines like his, confirmed by actual experience, and afterwards improved by Mayow, should be so long lost to the world, and that Dr. Hunter, a lecturer of great learning, should say, not twelve years ago, " that the office of the lungs is *unknown* to us at the present day, and if we are ever fortunate enough to find this out, we shall as surely perceive that this organ is designed from some very important function, as we know the heart, and the other organs possess very important offices." Till of late the whole of chemisty was a mere jargon throughout, and it is curious, that what is called modern improvement should be only the bringing us back to the old beaten path. You see also, what accidents give rise to great things. An apple tossed in the air by a child made Sir Isaac Newton reflect on the reason of its falling, and he made projection and gravity the two principles that unlocked the whole mystery

JOHN MAYOW, M.D.

Engraved by J. Caldwall from an Original Drawing from Life by Loggan.

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of the motions of the heavenly bodies. So the contemplation of a piece of burnt wood, disclosed the vegetable anatomy, and the true system of chemistry, and the only rational physiology, which now that physicians have turned their attention to it, one day or other promises to be the greatest blessing to the human race.

As I am about to draw the first line of the next sketch, my hand is suspended by the intrusion of a wish, that has often before mixed with my thoughts. It may, perhaps, be not a very inviting task, but methinks in the superfluity of literary men, one at least might be spared from other services, to explore the dark volumes of ancient chemistry. Should any one, however, be able, so far to subdue his disgust, as to define, by careful inquiry, what degree of knowledge has been acquired from synthesis and analysis concerning the constitution of bodies before the middle of the last century, I am ready to believe, that he would find more credit due to MAYOW, says Dr. Beddoes, than I dare venture at present to ascribe to him. "*He was acquainted* " *with the composition of the atmosphere,—and perceived* " *the action of VITAL AIR in almost all the wide extent* " *of its influence. He was well aware of the cause of the* " *increase of weight in metallic calces; and distinctly as-* " *serted, that certain bases are rendered acid by the acces-* " *sion of the vital air, or what has been since called oxygen,* " *or the acidifying principle. His doctrine of respiration* " *is equally just. He has carried on his investigation of this* " *function from the diminution of the air by the breathing* " *of animals, to the change it produces in the blood during* " *its passage through the lungs. The office of the lungs,*" says he, "*is to separate from the air, and convey to the blood* " *one of its constituent parts.*" At the age of twenty-six he formed the peculiar system, continues Dr. Beddoes, which pervades all his works. The Dutch translator of his writings (an honour which they did not obtain from any other people), in the preface to them, affirms, "*that his philosophy found very little approbation in his own age.*" So much does the fortune both of truth itself, and of those who speak it, depend upon the disposition of the times in which it is spoken. None indeed smiled upon the fair features of this new-born offspring of science. His name, therefore, as it never was echoed by popular applause, was soon forgotten among men, and his memory obliterated. In the *Biographia Britannica* there is no article appropriated to him. But henceforth, I hope, that when the enthusiasm of an Englishman salutes his country, as

> Magna parens frugum !———
> Magna virûm !

Mayow will be ranked in the list of her *illustrious men.*

Boyle was contemporary with Hook and Mayow; he was in opulent circumstances, and by the agreeableness of his manners, and goodness of his heart, he was peculiarly turned to the study of nature, which pleased him most, and the knowledge of which he cultivated in the way recommended by Lord Bacon. He was possessed of that penetration and ingenuity of mind, which in experimental philosophy serves to point out the shortest, simplest, and most useful, experiments, and which enabled him to deduce the most important truths from the most simple and insignificant facts. These are the talents we distinguish in an eminent degree in this philosopher, and for which Sir Isaac Newton was afterwards so remarkable. He examined the prevailing philosophy of the chemists, and exposes its weakness; but he does it with a temper, candour, and modesty, which is truly admirable. He introduced the employment of tests, or active agents, for the discovery of the presence of chemical bodies. What Van Helmont called *gas,* Boyle denominated *artificial air.*

Furnished with the new instruments with which he has enriched natural philosophy, he repeated all Van Helmont's experiments in vacuo, in condensed air, and in the open air. He made numerous discoveries in this branch of science, and did not fail to notice that there are bodies such as charcoal, sulphur, &c. "which *diminish* the vo-"lume of air in which they burn."

Hitherto chemistry, though it was much advanced, had been treated only in a desultory manner. A great number of facts were discovered; but none had attempted to generalize them, and form a system; and though many particulars were known, yet the science itself was not in existence.

The illustrious BECHER first began to collate, examine, and compare, the immense store of chemical facts, and observe their relations. This man, whose genius equalled his knowledge, saw, with a single glance, the immense multitude of chemical phænomena. He invented the *theory* of PHLOGISTON, which soon obtained credit all over Europe. He was invited to Vienna, where he contributed to the establishment of several manufactures, a chamber of commerce, and an India company; but the jealousy of the ministry finally accomplished both his disgrace and ruin. He was not less unfortunate at Mentz, Munich, and Wurtzburg; which determined him to go to Haerlem, where he invented a machine for working a great quantity of silk in a little time and with few hands; but new disgraces and misfortunes made him retire to England, and he died in London in 1682, at the age of 57, of a broken heart.

"BECHER," says Professor Davy, "is the author of *Physica subterranea*, and *Œdipus chemicus*, which are very extraordinary productions. They display the efforts of a vigorous mind, the conceptions of a most fertile imagination, but the conclusions are too rapidly formed; there is a want of logical precision in his reasonings; the objects he attempted were grand, but his means of execution comparatively feeble. He endeavoured to raise a perfect and lasting edifice upon foundations too weak, from materials too scanty and not sufficiently solid; and the work, though magnificent in design, was rude, unfinished and feeble, and rapidly fell into decay.

"Becher added very little to the collection of chemical experiments, but he improved the instruments of research, simplified the manipulations, and by the novelty and boldness of his speculations, excited enquiry amongst his disciples.

"His most distinguished follower was George Ernest Stahl, born in 1660, who soon attained a reputation superior to that of his master, and developed doctrines which for nearly a century constituted the theory of chemistry of the whole of Europe."

The theory invented by Becher was adopted and commented upon by STAHL. Born, as Becher was, with a strong passion for chemistry, which shewed itself in its early youth, he inherited a genius equal to that of Becher. His imagination was as lively, as brilliant, and as active, as that of his predecessor, and he had the advantage of being heard with attention. In the opinion of these two philosophers *fire* enters into the composition of all inflammable bodies, and into metals and most minerals, and in that condensed, compacted, fixed state, it was called PHLOGISTON* (latent fire), to distinguish it from its condition when in a free state.

We behold flame, we see bodies consumed, we feel a pleasing, and sometimes a painful sensation, when we approach within the sphere of these phænomena. Now is this fire as much a material body, as a piece of wood, or glass, or stone, or any other substance? If it be, whence does it arise? and what becomes of it?—We neither saw or felt it before the body was kindled; and when the fuel is consumed, it no longer appears? In answer to these questions Becher and Stahl tell us,—that *fire*, or PHLOGISTON, is actually a material body, and liable to be modified by the influence of circumstances. In bodies subject to burn, it exists in a latent state:—place them in circumstances in which combustion is produced—you then will behold it, perceive it operate, and feel its influence.—In bodies, as metals, though you do not perceive the flame, yet will you discover this principle by the alteration of their properties. Hence it is,

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* A word derived from the Greek word Φλωξ, γος, flame, or fire.

If you take a piece of SULPHUR, and set it on fire, it will burn entirely away, without leaving any ashes, or yielding any soot. During the burning of the sulphur, a copious vapour, powerfully affecting the organs of sight and smell, and the action of the lungs, is dispersed. Means have been invented for collecting this vapour, and it is found to be a very strong acid. The acid thus procured from the burning of the sulphur, is incapable of being either burnt by itself, or of contributing towards the support of fire in other bodies; the sulphur from which it was procured was capable of both: there is a remarkable difference, then, between the acid procured from the sulphur, and the sulphur itself. The acid is not the only constituent part of the sulphur:—is it not evident then that it must have contained *something* else, by which it was rendered capable of combustion? This *something* is, from its remarkable property of rendering a body combustible, denominated therefore PHLOGISTON, or the *inflammable principle.*

If you burn CHARCOAL in the open air, and hold a glass over its flame, you will perceive that it burns without emitting either any watery vapour or sooty impurity; and nothing will remain, from a large portion of charcoal, but a small quantity of white ashes, which are incapable of any further combustion. The principle effecting the combustion of the charcoal, and dispersed by the act of combustion, is the PHLOGISTON.

If you set SPIRITS OF WINE on fire, they will, if pure, burn entirely away; they differ from charcoal in this, that they emit a vapour: but they leave no residuum. You may, by proper vessels, collect the vapour of burning spirits, and you will find it to be an insipid water, incapable of combustion. The principle effecting the combustion of the spirits of wine, and dispersed by the act of combustion, is the PHLOGISTON.

Some METALLIC SUBSTANCES burn, when sufficiently heated, with a flame more bright than that of spirits of wine or charcoal; others burn or smother away like rotten wood; and most of them, when they have been kept in the open air in a proper degree of heat, lose their metallic appearance, and are converted into earth. Thus red lead or minium is the earth procured from the burning of lead; and putty, such as the polishers of glass and marble use, is the earth procured from tin. The principle effecting the combustion of metallic substances, and dispersed in the act of combustion, is PHLOGISTON.

The *acid* of *sulphur*;—the *ashes* of *charcoal*;—the *water* of the *spirit* of *wine*; the *earths* of *metallic substances*, are utterly incapable of combustion: their respective differences from SULPHUR, CHARCOAL, SPIRITS OF WINE, and METALLIC SUBSTANCES, with respect not only to *inflammability*, but to *smell*, *colour*, and *other properties*, are attributed to the PHLOGISTON which is dispersed during the combustion of each of them.

From the ANALYSIS or decomposition of SULPHUR, we conclude that the constituent parts of sulphur are two—an *acid* which may be collected; and an *inflammable principle* which is dispersed. The reader will wish to see this ANALYSIS confirmed by synthesis, that is, in common language, he will wish to see sulphur actually made by combining its *acid* with the *inflammable principle.*

X

As this *inflammable principle* cannot be obtained in a palpable form separate from all other bodies, the only method by which we can attempt to unite it with the acid of sulphur, must be by presenting to that acid some substance in which it is contained.—Charcoal is such a substance, and by distilling powdered charcoal and the acid of sulphur together, we can produce undoubted sulphur. This sulphur is formed from the union of the acid with the *phlogiston*; and the charcoal may be by this means so entirely robbed of its *phlogiston*, that it be reduced to the state it is found after complete combustion in the open air.

Spirits of wine, we have said, consists of *phlogiston* united with *water*:—and if we distil spirits of wine and the acid of sulphur mixed together, we shall obtain a pure yellow sulphur, in no way to be distinguished from common sulphur.

But one of the shortest and most obvious ways of illustrating both the composition of sulphur and *phlogiston* of metallic substances is the following.—Upon melted lead pour the acid of sulphur; collect the vapour which will arise, by holding a very large glass or other vessel over the melted lead, and you will, as soon as the vapour is condensed, observe several filaments of sulphur sticking to the sides of the glass. Here, when the lead is in a state of strong fusion, its *phlogiston* is in a state of dispersion; and the acid of sulphur spontaneously unites itself with this *phlogiston*, and forms sulphur.

I will in this place, by way of further illustration of the doctrine of PHLOGISTON, add a word or two concerning the necessity of its union with a metallic earth, in order to constitute a metal.

Lead, it has been observed, when melted in a strong fire, burns away like rotten wood; all its properties as a metal are destroyed, and it is reduced to ashes.—If you expose the ashes of lead to a strong fire, they will melt; but the melted substance will not be a metal, it will be a yellow or orange-coloured glass.—If you pound this glass, and mix it with charcoal dust, or if you mix the ashes of the lead with charcoal dust, and expose either mixture to a melting heat, you will obtain, not a glass, but a *metal*, in weight, colour, consistency, and every other property, the same as lead.

This operation, by which a metallic earth is restored to its metallic form, is called reduction. The ashes of lead melted without charcoal is *glass*;—the ashes of lead melted with charcoal becomes a *metal*; the charcoal must then have communicated SOMETHING to the ashes of lead, by which they are changed from a glass to a metal.

Charcoal consists of two things, of *ashes*, and of *phlogiston*; the ashes of charcoal, though united with the ashes of lead, would only produce *glass*; it must therefore be the other constituent part of charcoal, or *phlogiston*, which is communicated to the ashes of lead, and by an union with which the ashes are restored to their metallic form.

The ashes of lead we see then can never be reduced to their metallic form, without their being united with some matter containing *phlogiston*; and they may be reduced to their metallic form, by being united with *any* substance containing *phlogiston* in a proper state, whether that substance be derived from the animal, vegetable, or mineral kingdom (for tallow, or iron filings, may be substituted with success in the room of charcoal, in the experiment of reducing the lead); and thence we conclude, not only that PHLOGISTON is a necessary part of a metal, but that it has *an identity* belonging to it, from *whatever substance* it be extracted.

" Though misled in his general notions," says Professor Davy, " few men have done more than Stahl for the progress of chemical science.—His processes were, many of them, of the most beautiful and satisfactory kind: he discovered a number of properties of the caustic alkalies and metallic calces, and the nature of sulphureous acid; he reasoned upon all the operations of chemistry in which gaseous bodies were not concerned, with admirable precision. He gave an axiomatic form to the science, banishing from it vague details, circumlocutions and enigmatic descriptions, in which even Becher had too much indulged; he laboured in the spirit of the Baconian school, multiplying instances, and cautiously making inductions, and appealing in all cases to experiments which, though not of the most refined kind, were more perfect than any which preceded them."

Thus error triumphed over truth, and the *English school* of chemistry was forgotten, or overlooked, when HALES, in 1724, resumed the investigation begun by Hook, Mayow, and Boyle.

The experiments of these philosophers had made it evident that a great quantity of elastic fluid analogous to air was separated from bodies in many operations;—that also in some other operations a portion of atmospheric air was absorbed; but no one had any idea of the *exact quantities* either produced or absorbed.

Dr. Hales was the first person who accomplished this useful purpose. Hence it did not escape this benevolent and indefatigable philosopher, that the quantity of air *absorbed* either by the burning of sulphur or of candles, or by the respiration of animals, presented different appearances, according to the quantity of air employed. He discovered that this absorption of air is limited, and that it never proceeded beyond a certain point.

Dr. Hales, in the course of his experiments, has observed also the alternate *production* and *absorption* of air, of which he, however, does not seem to have understood the true cause; the burning of charcoal, and other substances, furnished him with a great increase of air, but that air diminished daily. This phænomenon depended upon the water which the Doctor used in these experiments: and it will be shewn hereafter, that most of these vapours, and particularly those which we are accustomed to denominate *fixed air*, have a great affinity for water, which is capable of absorbing more than its own bulk of *this air*.

The great number of experiments made by Dr. Hales, which may be found in chap. vi. of his *Vegetable Statics*, comprehends vegetable, animal, and mineral substances. He has examined into the effects of fermentation, chemical dissolutions and combinations, the combustion of bodies, and respiration. Too much cannot be said to induce the reader to peruse his inestimable work. He will find in it a most inexhaustible fund of meditation.

It is in this work, that we perceive the first traces of the existence of air in those waters, which are called *acidulous*. Dr. Hales has not only remarked that these waters contain four or five times more air than common water, but he also suspected that they owed their remarkable sparkling and briskness to this air.

All the philosophers of his time believed, that fire became fixed, and combined itself with metals, and that to this addition they owed their reduction to a state of calx. Dr. Hales has not only discarded this error, but he has moreover advanced that air contributed to produce that effect, and that to it alone must be attributed the augmentation in the weight of metallic calces. He grounded his opinion chiefly in having obtained from 1922 grains of lead only seven cubic inches of air;—whereas an equal quantity of minium afforded him 34 cubic inches*.

Dr. Hales, in summing up his knowledge on this subject, compares the air to a true Proteus, now fixed, now volatile, entering into the composition of bodies, where it exists in a solid form, deprived of elasticity, and of those properties which formerly distinguished it, adding gravity to these bodies, and under certain circumstances alone capable of recovering its elasticity, and becoming again an elastic and thin fluid, and therefore deserving to be adopted among chemical principles, and to possess a rank which has hitherto been denied it.

The immortal BOERHAAVE, the honour of his country, of his profession, and of his age, next improved upon the experiments of Dr. Hales, by not permitting the factitious airs to have any communication with *water*. "It must be acknowledged," says he, "that by chemistry we separate from bodies an *elastic vapour*, and consequently that this aerial matter resides in them, but in such a manner as not to have the properties of air, as long as it is combined and united;—but that whenever it is detached, it resumes its former nature, and becomes *true air*, disposed to reunite with other substances again, and remain quiet, but without losing its real nature; for whenever it is freed from the bonds which retain it, it shews itself to be the same body. Nothing can be more certain than this *resolution* and *composition*; and I would have given," continues Dr. Boerhaave, " many examples of it, had I not lately read Dr. Hales' celebrated treatise on Vegetable Statics; in the sixth chapter of which book, the author has collected with so much labour and justness, and has related in the best possible order, the experiments which have been made on this subject, so that he has exhausted the subject. To these I refer my readers, and they will see how ART has arrived at the power of *unveiling* NATURE."

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* These must have been *oxygen air*. But, I believe, neither Hook, Mayow, or Hales, knew this pure air, however ingeniously they might have reasoned about the nitro-aerial particles as a constituent part of the atmosphere; although each had obtained it distinct, as their several works sufficiently demonstrate.

It had indeed been observed, that certain substances, such as *marble*, *chalk*, and *limestone*, effervesced with acids; —that these substances were insoluble in water; they were soft to the touch and inoffensive:—But when treated with fire they assumed directly contrary properties, not effervescing with acids;—being easily dissolved by water so as to form a transparent liquor; and lastly, they were rendered so caustic as to corrode all animal and vegetable substances. These curious phænomena had not escaped the notice of attentive observers of former times; but the honour of first satisfactorily explaining the true cause of these events seemed reserved for the illustrious professor of chemistry at Edinburgh, Dr. BLACK.

In 1756 this philosopher published his admirable researches on calcareous, magnesian, and alkaline substances, by which he proved the existence of a gaseous body, perfectly distinct from the air of the atmosphere. He shewed that quicklime differed from marble and chalk by containing this substance, and that it was a weak acid, capable of being expelled from alkaline and earthy substances by strong acids*.

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* Vide Essays and Observations Physical and Literary, vol. ii. p. 159.

Ideas so new and important as those of the British philosopher, were not received without opposition; several German enquirers endeavoured to controvert them. Meyer attempted to shew that limestones became caustic, not by the emission of elastic matter, but by combining with a peculiar substance in fire; but the loss of weight was perfectly inconsistent with this view: and Bergman at Upsal, Macbride in Ireland, Keir at Birmingham, and Cavendish in London, demonstrated the correctness of the opinions of Black; and a few years were sufficient to establish his theory upon immutable foundations.

He discovered, that by the process of fire, these substances lost half their former weight, and when treated with acids the compound weighed lighter than before. *Something* therefore was lost. In a treatise, which indeed is a fine specimen of the best method of investigating and demonstrating chemical truths, he ascertained "*what this SOMETHING was,*" and proved it to be a permanently elastic fluid, which he therefore denominated FIXED AIR, deprived of which the residue was caustic or *quicklime*— having those properties first enumerated. DR. RUTHERFORD extended this inquiry, and determined the difference betwixt fixed, and azotic, airs.

Hitherto the existence of *fixed air*, and its combination with bodies was a physical opinion, and no physiologist since Van Helmont had adopted it, when the amiable and learned MACBRIDE, professor of physic at Dublin, examined into the medical properties of *this air*, and established by the most decisive experiments, its *antiseptic properties.* He ascertained, that flesh which is half putrid, having lost a portion of the *fixed air* which enters into its composition, may recover its former sweetness, by restoring to it its *fixed air*; to produce which effect, it will be sufficient to expose it to the vapours of any fermenting substance, or rather to a current of *fixed air* from an effervescing mixture.

Soon after the publication of DR. MACBRIDE's treatise, the HON. MR. CAVENDISH communicated to the Royal Society some new experiments confirming the doctrines of these two eminent professors. He further shewed that water is capable of absorbing a volume of *fixed air* more than equal to itself; that this quantity is proportionably greater as the water is colder, and is compressed by a heavier atmosphere; that water thus impregnated with fixed air has all the acidulous and spirituous taste of Seltzar water. Mr. Cavendish determined the quantities of fixed and inflammable gases obtained from different substances: he ascertained their specific gravities: and introduced, or at least set the example, by his accurate mode of experimenting, of establishing a complete system of *pneumatic chemistry*.

MR. LANE discovered that water impregnated with *fixed air* has the property of dissolving almost all metals, and especially iron and zinc; a very small quantity of these metals being sufficient to communicate to water their taste and virtues.

Soon after DR. PRIESTLEY entered upon his career, and proceeded with such rapidity of success, that he attracted the attention of philosophers of all nations to these and similar objects, and excited their emulation in the same pursuit; and thereby he has given rise to such auspicious consequences in chemistry, that his entry into this branch of experimental philosophy will be ever considered as an æra in the annals of chemistry.

It is impossible to compress his numerous discoveries in the limits of a few pages. They fill up six volumes; and as the knowledge of the *permanently elastic fluids* is the most important part of chemistry, and has in a manner given to this science an entirely *new appearance*, I would therefore recommend the reader to a careful study of the whole of his incomparable and entertaining works. I shall therefore here confine myself solely to the account he gives us of his discovery of *vital air*, which he denominates *dephlogisticated air.*

"On the 1st of August, 1774, I endeavoured," says this illustrious philosopher, "to extract air from *mercurius calcinatus per se*; and I presently found that, by means of a very large burning-glass, an *aerial fluid* was expelled very readily. Having got three or four times as much as the bulk of the materials, I admitted water to it, and found it was not fixed air, because water did not absorb it. But what surprised me exceedingly was, "*that when a candle was put into this*
" *newly acquired air, the flame, besides being larger, burnt*
" *with considerable more splendour, and heat, than in com-*
" *mon air*; *and a piece of burnt wood that had any redness*
" *in it, was rekindled and burnt away very fast, resembling*
" *by its crackling noise paper that had been dipped in a so-*
" *lution of nitre.*"

"I extracted," he adds, "in the same way, a quantity of *air*, with the very *same property*, from the common *red precipitate*, which had been produced by a solution of mercury in spirit of nitre, and hence I concluded that this peculiar property was derived in both instances from *nitrous particles*. I even thought that what was usually sold as the *mercurius calcinatus per se* was contaminated with *nitrous acid*. However, upon mentioning this suspicion to Mr. Waltire, he furnished me with some, which he assured me was genuine. This being treated in the same manner as the former, only by a longer continuance of heat, I extracted much more air from it than from the other. This experiment might have satisfied any other; but being at Paris in the October following, and knowing that there were several very eminent chemists in that place, I did not omit the opportunity to get an ounce of *mercurius calcinatus* prepared by Mons. Cadet; of the genuineness of which there could not possibly be any suspicion; and at the same time I frequently mentioned my surprise at *the kind of air* I had got from this preparation to Mons. Lavóisier, and several other philosophers who honoured me with their notice in that city.

"At the same time that I had obtained the air above described from the *mercurius calcinatus* and the *red precipitate*, I also procured some of the same kind from *minium*, or *red lead*. As I never made the least secret of any thing that I observed, I mentioned this experiment *also* to all my philosophic acquaintance at Paris, and elsewhere; having no idea at that time to what these remarkable facts would lead."

The French chemists, who had been inattentive to the admirable discoveries of Dr. Black and Mr. Cavendish, were roused by the striking phænomena which Dr. Priestley's discoveries presented. Their minds being prepared by the active and enlightened genius of the age, the spark was no sooner struck, than the most brilliant effects began to show themselves along the French meridian. Never was the passion for novelty, now concurring with philosophical ardour, more happily exerted among the philosophers of that lively nation, than in the cultivation of this ample field of knowledge, which had been first explored, and the richness of the soil demonstrated principally by our illustrious countrymen, Mayow, Boyle, Hales, Black, Cavendish, and Priestley. But the efforts of Dr. Priestley's discoveries were not confined to France. They passed to every country in Europe, and across the Atlantic. More extensive in their influence than the commotions of Calabria, they spread their better agitations, particularly into Germany, Italy, and Sweden; in which last kingdom they met the congenial spirit of two illustrious chemists, Bergman and Scheele; the *former* distinguished by the order, precision, and various abilities with which he improved chemistry; and the *other* by so numerous a train of discoveries as could only occur to a man who, like Scheele, joined to a profound knowledge of chemistry, an intuitive genius, and a laborions zeal. The discovery of *vital air*, the pride, as it is called, of modern philosophy, had slumbered for more than a century, when this illustrious philosopher drew it forth from nitre, and a variety of other substances, and called it *empyreal air*, a word which implies, "*formed of the element of fire*," or "*an air pure in the extreme*."

It is singularly curious, that two philosophers of the present day should both, and at the same time, and by different processes, discover this *wonderful gas*, which has thrown light on the whole œconomy of nature, and both of them be ignorant of the prior right of Hook and Mayow, of whose claim they certainly knew nothing.

BLACK, CAVENDISH, PRIESTLEY, and SCHEELE, to give the opinion of the most competent judge, (Professor Davy), "were undoubtedly the greatest chemical discoverers of the eighteenth century; and their merits are distinct, peculiar, and of the most exalted kind. Black made a smaller number of original experiments than either of the other philosophers; but being the first labourer in this new department of the science, he had greater difficulties to overcome. His methods are distinguished for their simplicity, his reasonings are admirable for their precision; and his modest, clear, and unaffected manner, is well calculated to impress upon the mind a conviction of the accuracy of his processes, and the truth and candour of his narrations.

"Cavendish was possessed of a minute knowledge of most of the departments of Natural Philosophy: he carried into his chemical researches a delicacy and precision, which have never been exceeded: possessing depth and extent of mathematical knowledge, he reasoned with the caution of a geometer upon the results of his experiments: and it may be said of him, what, perhaps, can scarcely be said of any other person, that whatever he accomplished, was perfect at the moment of its production. His processes were all of a finished nature; executed by the hand of a master, they required no correction; the accuracy and beauty of his earliest labours even, have remained unimpaired amidst the progress of discovery, and their merits have been illustrated by discussion, and exalted by time.

"Dr. Priestley began his career of discovery without any general knowledge of chemistry, and with a very imperfect apparatus. His characteristics were ardent zeal and the most unwearied industry. He exposed all the substances he could procure to chemical agencies, and brought forward his results as they occurred, without attempting logical method or scientific arrangement. His hypotheses were usually founded upon a few loose analogies; but he changed them with facility; and being framed without much effort, they were relinquished with little regret. He possessed in the highest degree ingenuousness and the love of truth. His manipulations, though never very refined, were always simple, and often ingenious. Chemistry owes to him some of her most important instruments of research, and many of her most useful combinations; and no single person ever discovered so many new and curious substances.

"Scheele possessed in the highest degree the faculty of invention; all his labours were instituted with an object in view, and after happy or bold analogies. He owed little to fortune or to accidental circumstances: born in an obscure situation, occupied in the duties of an irksome employment, nothing could damp the ardour of his mind or chill the fire of his genius: with very small means he accomplished very great things. No difficulties deterred him from submitting his ideas to the test of experiment. Occasionally misled in his views, in consequence of the imperfection of his apparatus, or the infant state of the inquiry, he never hesitated to give up his opinions the moment they were contradicted by facts. He was eminently endowed with that candour which is characteristic of great minds, and which induces them to rejoice as well in the detection of their own errors, as in the discovery of truth. His papers are admirable models of the manner in which experimental research ought to be pursued; and they contain details on some of the most important and brilliant phænomena of chemical philosophy."

At this time the *new*, or *antiphlogistic theory* sprang up in France. It derived its chief origin from LAVOISIER, who had soon the felicity of being joined by Berthollet, Morveau, Adet, Hazenfratz, De la Place, Monge, Chaptal, Fourcroy, and others, who have united their labours in establishing this *new system*; which, from such a combination of talents, could not fail of being exhibited with every advantage, and of fixing the attention of the philosophic world.

Till 1786, there had been no attempt to reform the nomenclature of chemistry; the names applied by discoverers to the substances which they made known, were still employed. Some of these names, which originated amongst the alchemists, were of the most barbarous kind; few of them were sufficiently definite or precise, and most of them were founded upon loose analogies, or upon false theoretical views.

It was felt by many philosophers, particularly by the illustrious Bergman, that an improvement in chemical nomenclature was necessary, and in 1787, Messrs. Lavoisier, Morveau, Berthollet, and Fourcroy, presented to the world a plan for an almost entire change in the denomination of chemical substances, founded upon the idea of calling simple bodies by some names characteristic of their most striking qualities, and of naming compound bodies from the elements which composed them.

The new nomenclature was speedily adopted in France; under some modifications it was received in Germany; and after much discussion and opposition, it became the language of a new and rising generation of chemists in England. It materially assisted the diffusion of the antiphlogistic doctrine, and even facilitated the general acquisition of the science; and many of its details were contrived with much address, and were worthy of its celebrated authors.

The new doctrines of chemistry, before 1795, were embraced by almost all the active experimental inquirers in Europe; and the adoption of a precise mode of reasoning, and more refined forms of experiment, led not only to the discovery of new substances, but likewise to a more accurate acquaintance with the properties and composition of bodies that had long been known.

New investigations were instituted with respect to all the productions of nature, and the immense variety of substances in the mineral, vegetable, and animal kingdom, submitted to chemical experiments.

The analysis of mineral bodies first attempted by POTT in experiments principally on their igneous fusion, and afterwards refined by the application of acid and alkaline menstua, by MARGRAAF, BERGMAN, BAYEN, and ACHARD, received still greater improvements from the labours of KLAPROTH, VAUQUELIN, and HATCHETT. HOFFMAN, in the beginning of the 18th century, pointed out *magnesia* as a peculiar substance. MARGRAAF, about fifty years later, distinguished accurately between the *silicious*, *calcareous*, and *aluminous* earths. SCHEELE, in

1774, discovered *barytes*. Klaproth, in 1788, made known *zircone*. Dr. Hope, *strontites* in 1791. Gadolin, *ittria* in 1794; and Vauquelin, *glucine* in 1798.

Seven metals only had been accurately known to the ancients, gold, silver, lead, mercury, copper, tin, and iron. Zinc, bismuth, arsenic, and antimony, though mentioned by the Greek and Roman authors, yet were employed only in certain combinations, and the production of them in the form of reguli or pure metals, was owing to the alchemists.

Cobalt had been used to tinge glass in Saxony in the 16th century; but the metal was unknown till the time of Brandt, and this celebrated Swedish chemist discovered it in 1733. *Nickel* was procured by Cronstedt in 1751. The properties of *manganese*, which was announced as a peculiar metal by Kaim in 1770, were minutely investigated by Scheele and Bergman a few years after. *Molybdic acid* was discovered by Scheele in 1778, and a *metal procured from it* by Hielm in 1782, the same year that *tellurium* was made known by Muller. Scheele discovered *tungstic acid* in 1781, and soon after *a metal was extracted from it* by Messrs. D'Elhuyars. Klaproth discovered *uranium* in 1789. The first description of the properties of the *oxyd of titanium* was given by Gregor in 1791. Vauquelin made known *chromium* in 1797. Hatchett *columbium* in 1801; and shortly after, the same substance was noticed by Ekeberg, and named by him *tantalium*. *Cerium* was discovered in 1804, by Hessinger and Berzelius. *Platina* had been brought into Europe and examined by Lewis in 1749: and in 1803, Descotils, Fourcroy, and Vauquelin announced *a new metallic substance in it*; but the complete investigation of the properties of this extraordinary body was reserved for Messrs. Tennant and Wollaston, who in 1803 and 1804 discovered in it no less than *four new metallic substances*, besides the body which exists in it in the largest proportion, namely, *iridium*, *osmium*, *palladium*, and *rhodium*.

The attempts made to analyse vegetable substances previous to 1720, merely produced their resolution into the supposed elements of the chemists of those days, namely, salts, earths, phlegm, and sulphur. Boerhaave and Newmann attempted an examination by fluid menstrua, which was pursued with some success by Rouelle, Macquer, and Lewis. Scheele, between 1770 and 1780, pointed out several new vegetable acids. Fourcroy, Vauquelin, Deyeux, Seguin, Proust, Jacquin, and Hermbstadt, between 1780 and 1790, in various interesting series of experiments, distinguished between different secondary elements of vegetable matter, particularly *extract*, *tannin*, *gums*, and *resinous* substances; and investigations of this kind have been pursued with great success by Hatchett, Pearson, Shræder, Chenevix, Gehlen, Thomson, Thenard, Chevreul, Kind, Brande, Bostock, and Duncan. The chemistry of animal substances has received great elucidations from several of the same inquirers: and Berzelius has examined most of their results, and has added several new ones, in a comprehensive work expressly devoted to the subject, published in 1788.

That solid masses fell from above, connected with the appearance of meteors, had been advanced as early as 500 years before the Christian æra, by Anaxagoras; and the same idea had been brought forward in a vague manner by other inquirers amongst the Greeks and Romans, and was revived in modern times: but till 1802, it was regarded by the greater number of philosophers as a mere vulgar error, when Mr. Howard, by an accurate examination of the testimonies connected with events of this kind, and by a minute analysis of the substances said to have fallen in different parts of the globe, proved the authenticity of the circumstance, and shewed that these meteoric productions differed from any substances belonging to our earth; and since that period a number of these phænomena have occurred, and have been minutely recorded.

The philosophy of heat, the foundations of which were laid between 1757 and 1785, by BLACK, WILCKE, CRAWFORD, IRVINE, and LAVOISIER, since that period has received some new and very important additions, from the inquiries of PICTET, RUMFORD, HERSCHEL, LESLIE, DALTON, and GAY LUSSAC. The circumstances under which bodies absorb and communicate heat, have been minutely investigated; and the important discoveries of the different physical and chemical powers of the different solar rays, and of a property analogous to polarity in light, bear immediate relation to the most refined doctrines of corpuscular science, and promise to connect, by close analogies, the chemical and mechanical laws of matter.

A general view of the philosophy of chemistry was published under the name of Chemical Statics, in 1803, by the celebrated BERTHOLLET. It is a work remarkable for the new views that it contains on the doctrines of attraction, views which are still objects of discussion, and which bear an immediate relation to some of the conclusions depending upon very recent discoveries.

At the time when the antiphlogistic theory was established, electricity had little or no relation to chemistry. The grand results of FRANKLIN, respecting the cause of lightning, had led many philosophers to conjecture, that certain chemical changes in the atmosphere, might be connected with electrical phænomena;—and electrical discharges had been employed by CAVENDISH, PRIESTLEY, and VANMARUM, for decomposing and igniting bodies; but it was not till the era of the wonderful discovery of VOLTA, in 1800, of a new electrical apparatus, that any great progress was made in chemical investigation by means of electrical combinations.

Nothing tends so much to the advancement of knowledge as the application of a new instrument. The native intellectual powers of men in different times, are not so much the causes of the different success of their labours, as the peculiar nature of the means and artificial resources in their possession. Independent of vessels of glass, there could have been no accurate manipulations in common chemistry: the air pump, was necessary for the investigation of the properties of gaseous matter; and without the *Voltaic* apparatus, there was no possibility of examining the relations of electrical polarities to chemical attractions.

By researches, the commencement of which is owing to Messrs. NICHOLSON, and CARLISLE, in 1800, which were continued by CRUICKSHANK, HENRY, WOLLASTON, CHILDREN, PEPYS, PFAFF, DESORMES, BIOT, THENARD, HISSINGER, and BERZELIUS, it appeared that various compound bodies were capable of decomposition by electricity; and experiments proved that several substances which had never been separated into any other forms of matter in the common processes of experiment, were susceptible of analysis by electrical powers; in consequence of these circumstances, the *fixed alkalies* and several of the *earths* have been shewn to be *metals combined with oxygen.*

These discoveries were made by DAVY, a young man, whose superior genius, Doctor Beddoes, the late Professor of Chemistry at Oxford, noticed, and brought up from

Cornwall to receive his instructions, and also aid the Doctor in his chemical pursuits.

After having passed some time under the roof of that philosopher, an opening occurred for the promotion of rising talent in the Royal Institution, and he obtained the honourable appointment of chemical lecturer.

The resources of a rich nation were expended in chemical apparatus, and every thing conspired to render him the first chemist of the age; and his discoveries have done honor to the English school of chemists, and established an eternal fame.

Speaking of these discoveries, Davy says, with a becoming boldness *, " the number of metals known, or the existence of which may be presumed, amounts to 38. The characteristic properties of the metals are a high degree of lustre, opacity, combustibility, and the power of conducting electricity. A considerable degree of specific gravity was formerly considered as an essential character of metallic substances; but I have discovered bodies *lighter* even than water, which agree in all other essential qualities with metals, and which consequently must be arranged with them.

" There is a body usually called *potash* or the *vegetable alkali*, which may be thus procured : quick lime is mixed with solution of wood-ashes, and boiled for some time with it. The liquor so obtained, after being passed through bibulous paper, is evaporated till a solid matter remains; this solid matter is heated with alcohol or pure spirit; the spirit is separated by distillation in a vessel of silver; a fusible solid mass is produced, which is the substance in question.

" To form *potassium*, this substance in a thin piece, is placed between two discs of platina connected with the extremities of a Voltaic apparatus of 200 double plates; it will soon undergo fusion, oxygene will separate at the positive surface, and small metallic globules will appear at the negative surface, which consist of potassium. I discovered this metal in the beginning of October 1807.

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* Elements of Chemical Philosophy, p. 319.

" *Potassium* is possessed of very extraordinary properties; it is lighter than water, its specific gravity is between 8 and 9, water being 10. It is a solid at common temperatures; it is very soft, and easily moulded by the fingers. It fuses at about 150° Fahrenheit, and rises in vapour, in a heat a little below that of redness. It is perfectly opaque. Its colour is white, like that of silver when it is newly cut, but it rapidly tarnishes in the air; and to be preserved from change must be kept under naphtha. It is a conductor of electricity. When thrown upon water it acts with great violence, swims upon the surface, and burns with a beautiful light, which is white mixed with red and violet; the water in which it burns is found alkaline, and contains a solution of potassa. It inflames when gently heated in the air, burns with a red light, and throws off fumes, which are alkaline. It burns spontaneously in chlorine with intense brilliancy.

" *Sodium* may be procured exactly in the same manner as potassium, by electrical or chemical decomposition, the mineral alkali, or the alkali from the ashes of marine plants being used insteal of pearl ashes. Rather a higher degree of heat is necessary for its production by the action of iron. I discovered sodium a few days after I discovered potassium, in the year 1807.

" In many of its characters it resembles potassium; it is as white as silver, has great lustre, and is a conductor of electricity. It enters into fusion at about 200° Fahrenheit, and rises in vapour at a strong red heat. Its specific gravity is between 9 and 10. When heated strongly in oxygene or chlorine, it burns with great brilliancy. When thrown upon water it effervesces violently, but does not inflame, swims on the surface, gradually diminishes with great agitation, and renders the water a solution of soda. It acts upon most substances in a manner similar to potassium, but with less energy. It tarnishes in the air, but more slowly, and like potassium it is best preserved under naphtha.

" There is a mineral substance found in Cumberland, Yorkshire, and other parts of Britain, called Witherite, or carbonate of *baryta.* By dissolving this substance in dilute solution of nitric acid, evaporating the solution to dryness, and heating the salt obtained to whiteness, a light fawn-coloured powder is procured, which is baryta or barium combined with oxygene. To obtain *barium*, a quantity of this substance is made into a paste, with water, and placed on a plate of platina; a cavity is made in the paste to receive a globule of mercury; the mercury is rendered negative, the platina positive, by means of a Voltaic battery, containing about 100 double plates.

" In a short time an amalgam will be formed, consisting of mercury and barium. This amalgam must be introduced into a little tube made of glass free from lead, which must be bent in the form of a retort, filled with the vapour of naphtha, and hermetically sealed. Heat must be applied to the end of the tube containing the amalgam, till all the mercury has been driven off; there will remain a solid difficultly fusible metal, which is barium.

" I first gained indications of the decomposition of baryta, in the end of October 1807, and I obtained an alloy of it with iron, in March 1808. The process of electrifying mercury, in contact with the earth, was pointed out to me in the course of my enquiries, by M. M. Berzelius and

Pontin of Stockholm, in May 1808; and in the beginning of June in the same year, I obtained *the metal.*

" Barium, as procured by heating the amalgam, appeared of a dark grey colour, with a lustre inferior to that of cast iron. It was considerably heavier than sulphuric acid, for though surrounded by globules of gas, it sunk immediately in that fluid. It instantly became covered with a crust of baryta, when exposed to air, and burnt with a deep red light, when gently heated. When thrown into water it effervesced violently, disappeared, and the water was found to be a solution of baryta.

" Barium as yet has been obtained only in very minute quantities. I have never possessed enough of it to ascertain its general chemical and physical characters, and no experiments upon it have been published by any other person.

" *Strontium* may be procured precisely in the same manner as barium: carbonate of strontia, or strontianite, a mineral found at Strontian in Scotland, being used instead of witherite. I first procured this metal in 1808, but in quantities too small to make an accurate examination of its properties. It seemed very analogous to barium, had not a very high lustre, appeared fixed, difficultly fusible, and not volatile. It became converted into strontia by exposure to air, and when thrown into water, decomposed it with great violence, producing hydrogene gas, and making the water a solution of strontia.

" *Calcium* may be obtained by the same processes as barium and strontium. Mild calcareous earth, or chalk being used instead of witherite and strontianite; or common well-burnt lime may be employed for making the paste, from which the mercurial amalgam is to be formed by Voltaic electricity.

" I first procured *calcium* about the same time as barium and strontium, but only in very minute quantities, so that little can be said concerning its nature. It appeared brighter and whiter than these two metals, and burnt, when gently heated, producing dry lime. I have had no opportunity of examining its general physical and chemical qualities.

" *Magnesium* may be procured from the earth called magnesia, which is the same as the calcined magnesia of druggists, by processes similar to those referred to in the three preceding sections; but a much longer time is required to produce an amalgam of magnesium and quicksilver, by electrical powers, than to produce amalgams of the metals of the other alkaline earths.

" I succeeded in decomposing magnesia likewise, in the following manner: I passed potassium in vapour through magnesia, heated to intense whiteness, in a tube of platinum, out of the contact of air; I then introduced a small quantity of mercury, and heated it gently for some time in the tube. An amalgam was obtained, which by distillation, out of the contact of the atmosphere, afforded a dark gray metallic film, which was infusible at the point at which plate glass softened, and which, in the process of distillation of the mercury, rendered the glass black at its point of contact with it. This film burnt when heated strongly, with a red light, and became converted into a white powder, which had the character of magnesia: when a portion of the metal was thrown into water, it sunk to the bottom, and effervesced slowly, becoming covered with a white powder; by adding a little muriatic acid to the water, the effervescence was violent; the metal rapidly disappeared, and the solution was found to contain magnesia.

" I have made several experiments with the hope of obtaining larger quantities of magnesium, such as might have enabled me to examine its chemical and physical properties; but without success. It is very difficult to procure a pure amalgam of magnesium by potassium and mercury; the heat must be intense; and at a high temperature, potassium acts with great energy upon platina, so that unless the tube is very solid, it is destroyed in the process, and when the heat is not very great, potassium remains in the tube, which is found afterwards in the amalgam. The potassium may however be separated by the action of water; which, even in the amalgam, rapidly converts it into potassa, but which has a much feebler action on magnesium. When the amalgam contains potassium, it likewise usually contains platinum, which is very soluble in the compound of potassium and quicksilver.

" When a solution of ammonia or of potassa, not in excess, is thrown into a solution of alum, a substance falls down, which when well washed, and dried at a red heat, is alumina. This substance appears to contain a peculiar metal, but as yet *Aluminum* has not been obtained in a perfectly free state, though alloys of it with other metalline substances have been procured sufficiently distinct to indicate the probable nature of alumina. Alumina cannot be decomposed by the electrization of mercury in contact with it, in the same manner as the alkaline earths. The first experiment by which I obtained evidences of its composition, was made in 1808, by fusing iron negatively electrified in contact with it; the earth was moist in this process, and a very high Voltaic power was applied. The globule of metal obtained was whiter than pure iron; effervesced slowly in water, becoming covered with a white powder, and the solution in muriatic acid decomposed by an alkali, afforded alumina and oxide of iron.

" By passing potassium in vapour, through alumina heated to whiteness, the greatest part of the potassium became converted into potassa, which formed a coherent mass with that part of the alumina not decompounded, and in this mass there were numerous gray particles, having the metallic lustre, and which became white when heated in the air, and which slowly effervesced in water. In a case in which a similar experiment was made, a strong red heat only being applied to the alumina, a mass was obtained, which took fire spontaneously by exposure to air, and which effervesced violently in water, and which probably contained the basis of alumina united to potassium.

" There is an earth which was discovered by Vauquelin in 1798, called glucine, or glucina, It may be obtained from the beryl or the emerald, by the following process; the stone, in fine powder, must be ignited for half an hour in a crucible of silver or platina, with three times its weight of hydrat of potassa or soda. The mass must be dissolved in solution of muriatic acid, and the compound obtained exposed to heat till it is dry. Water is then added to it, and the aqueous solution obtained acted on by solution of carbonate of potassa; a white powder is obtained which must be dissolved in diluted oil of vitriol not added in excess; a little of the salt called vitriolated tartar, or sulphate of potassa, must be mixed with the solution, and the whole evaporated till it begins to crystallize; crystals of alum will form. When no more can be obtained, the remaining liquor must be mixed with solution of carbonate of ammonia added in great excess; the mixed liquor must be passed through bibulous paper, evaporated to dryness, and the solid matter remaining heated to redness, it is then *glucina.*

" There is great reason to believe that glucina is a compound of a peculiar metallic substance, which may be called *glucinum* and oxygene. The evidence that such is its composition, I have obtained, by heating it with potassium in the same manner as alumina: the potassium was for the most part converted into potassa, and dark coloured particles having a metallic appearance were found diffused through the mass, which regained the earthy character by being heated in the air, and by the action of water, and in this last case hydrogene was slowly disengaged.

"Glucina in its pure form appears as a white powder without taste or smell, it requires an intense degree of heat for its fusion; it is not soluble in water in any perceptible degree, it does not alter the colour of vegetable blues or yellows. When it is thrown down from an acid solution, by an alkali, it exists in combination with water, as an hydrat. It forms sweet-tasted salts soluble in water, with the acids, and hence it gained its name, from γλυκυς, sweet.

"There is a peculiar earth, which was discovered by M. Klaproth, in 1793, and which may be procured from a stone found in Ceylon, and called the *jargon*, or *zircon*, and likewise from the hyacinth, by the following process. The powder of these stones must be ignited for a long while with hydrat of potassa; the substance which is not dissolved by the hydrate of potassa, is principally *zircon*. The soluble matters must be separated by water, and the insoluble matter boiled in muriatic acid, and the solution so obtained, evaporated to dryness, and heated to the temperature of 212°. An aqueous solution of zircona in muriatic acid, is obtained by the action of water on the solid mass; and pure zircona is procured by decomposing this solution by solution of ammonia, and heating the powder obtained to redness.

"There is the same evidence for believing that *zircona* is a compound of a metal and oxygene, as that afforded by the action of potassium on the other earths. The alkaline metal when brought into contact with zircona ignited to whiteness, is for the most part converted into potassa, and dark particles, which when examined by a magnifying glass, appear metallic in some parts, of a chocolate brown in others, are found diffused through the potassa and the undecompounded earth.

"Pure transparent quartz, or rock crystal, consists almost entirely of a peculiar earth called *silex* or *silica:* this earth may be procured from that stone or from common flints by igniting them in powder, with three or four times their weight of hydrat of potassa, or soda, in a silver crucible, making an aqueous solution of the substance so obtained, and adding to it any acid in quantities barely sufficient to neutralize the alkali, a gelatinous substance separates, which is *silica* combined with water; and the pure earth may be obtained by washing this substance well, and then igniting it to whiteness.

" That *silica* consists of oxygene united to a peculiar inflammable basis, which is probably metallic, is shewn by many experiments. When iron is negatively electrified, and fused by the Voltaic battery in contact with hydrat of silica, the metalline globule procured contains a matter which affords silex during its solution; and when potassium is brought in contact with silica ignited to whiteness, a compound is formed consisting of silica and potassa, and black particles not unlike plumbago are found diffused through the compound. From some experiments I made, I am inclined to believe that these particles are conductors of electricity; they have little action upon water, unless it contain an acid, when they slowly dissolve in it with effervescence; they burn when strongly heated, and become converted into a white substance having the characters of silica; so that there can be little doubt, both from analysis and synthesis, of the nature of silica; but no direct experiments have as yet been made upon the proportion of oxygene it contains.

" There is a mineral substance called Gadolinite, found at Itterby in Roslagen in Sweden, in which a peculiar earth was discovered in 1794, by Mr. Gadolin, and to which the name of *ittria* has been given. To procure this earth, the pulverized fossile must be digested for a considerable time in solution of muriatic acid. The solution obtained must be evaporated to dryness, redissolved in distilled water, and precipitated by caustic ammonia; the precipitate obtained must be digested with solution of hydrat of potassa; the remaining substance must be redissolved in solution of muriatic acid not used in excess, succinate of soda must be poured into this solution till all precipitation is complete; the filtered liquor must be decomposed by carbonate of soda, a white powder will fall down, which when ignited strongly, is pure *ittria.*

" When ittria is treated with potassium in the same manner as the other earths, similar results are obtained; the potassium becomes potassa, and the earth gains appearances of metallization, so that it is scarcely to be doubted that ittria consists of inflammable matter, metallic in its nature, combined with oxygene."

The conversion of these earths into metals forms some of the brilliant discoveries of Sir Humphry Davy, whose merits have been proclaimed by the National Institute, and knighthood conferred by his own country.

It is indeed a double source of interest in the science of chemistry, that whilst it is connected with the grand operations of nature, it is likewise subservient to the common processes as well as the most refined arts of life. New laws cannot be discovered in it, without increasing our admiration of the beauty and order of the system of the universe; and no new substances can be made known which are not sooner or later subservient to some purpose of utility.

Certain bodies which attract each other chemically, and combine when their particles have freedom of motion, when brought into contact, still preserving their aggregation, exhibit what may be called electrical polarities; and by certain combinations these polarities may be highly exalted; and in this case they become subservient to chemical decompositions; and by means of electrical arrangements the constituent parts of bodies are separated in an uniform order, and in definite proportions.

Bodies combine with a force, which in many cases is correspondent to their power of exhibiting electrical polarity by contact; and heat, or heat and light, are produced in proportion to the energy of their combination. Vivid inflammation occurs in a number of cases in which gaseous matter is not fixed; and this phænomenon happens in various instances without the interference of free or combined oxygene.

Experiments made by RICHTER and MORVEAU had shewn that, when there is an interchange of elements between two neutral salts, there is never an excess of acid or basis; and the same law seems to apply generally to double decompositions. When one body combines with another in more than one proportion, the second proportion appears to be some multiple or divisor of the first; and this circumstance, observed and ingeniously illustrated by Mr. DALTON, led him to adopt the atomic hypothesis of chemical changes, which had been ably defended by Mr. HIGGINS in 1789, namely, that the chemical elements consist of certain indestructible particles which unite one and one, or one and two, or in some definite numbers.

Whether matter consists of indivisible corpuscles, or physical points endowed with attraction and repulsion, still the same conclusions may be formed concerning the powers by which they act, and the quantities, in which they combine; and the powers seem capable of being measured by their electrical relations, and the quantities on which they act of being expressed by numbers.

In combination certain bodies form regular solids; and all the varieties of crystalline aggregates have been resolved by the genius of HAUY into a few primary forms. The laws of crystallization, of definite proportions, and of the electrical polarities of bodies, seem to be intimately related; and the complete illustration of their connection probably will constitute the mature age of chemistry.

To dwell more minutely upon the particular merits of the chemical philosophers of the present age, will be a grateful labour for some future historian of chemistry; but for a contemporary writer, it would be indelicate to assume the right of arbitrator, even where praise only can be bestowed. The just fame of those who have enlightened the science by new and accurate experiments, cannot fail to be universally acknowledged; and concerning the publication of novel facts there can be but one judgment; for facts are independent of fashion, taste, and caprice, and are subject to no code of criticism; they are more useful perhaps even when they contradict, than when they support received doctrines, for our theories are only imperfect approximations to the real knowledge of things; and in physical research, doubt is usually of excellent effect, for it is a principal motive for new labours, and tends continually to the developement of truth.

The slight sketch that has been given of the progress of chemistry, has necessarily been limited to the philosophical details of discovery. To point out in historical order the manner in which the truths of the science have been applied to the arts of life, or the benefits derived by society from them, would occupy many volumes. From the first discovery of the production of metals from rude ores, to the knowledge of the bleaching liquor, chemistry has been continually subservient to cultivation and improvement. In the manufacture of porcelain and glass, in the arts of dying and tanning, it has added to the elegancies, refinement, and comforts of life; in its application to medicine it has removed the most formidable diseases; and in leading to the discovery of gunpowder, it has changed the institutions of society, and rendered war more independent of brutal strength, less personal, and less barbarous."

Other ages may have surpassed the present in the greatness of some single event, such as the rapid conquest of half the globe by an ALEXANDER or a TAMERLANE. Nevertheless, the age in which we live, seems to me, of all the periods in history, the most distinguished for the sudden and extensive impulse which the human mind has received, and which has extended its active influence to every object of human pursuit. The diffusion of a general knowledge, and of a taste for science, over all classes of men, in every nation of Europe, or of European origin, seems to be the characteristic feature of the *present age.* The study of the sciences principally has expanded the mind, and laid it open for the reception of every kind of truth. Some individuals of rare genius in former times may perhaps seem to excel those of the present day; although in justice to these, it should be remembered, that luminous bodies shine brightest in obscurity. But in no former age, was ever the light of knowledge *so extended*, and so *generally diffused.* Knowledge is not now confined to public schools, or to particular classes of men. It is not at this day, that some celebrated and immensely learned professor delivers from his academic chair dictates to his auditors, who press from all quarters to catch the oracular sounds, and afterwards to revibrate his *ipse dixits.* In *this age*, the flame that passes over all, kindles the sparks of genius wherever they may happen to lurk, and every man studies for himself." Hence it is that, in our later pages, so many names crowd together; and it might naturally be asked, whilst *Chemistry* makes such rapid advances, shall *Medicine* continue inactive and stationary? The following pages, it is hoped, will shew that they go, in some measure, hand in hand.

A
REVOLUTION IN MEDICINE,
PRODUCED BY
THE NEW CHEMISTRY.

In nulla alia re homines proprius ad Deos accedunt, quam *salutem* hominibus dando ——CICERO.

OF all the discoveries, says Mons. FOURCROY, which has had influence on the art of healing, since the birth of experimental philosophy, there is none which has promised so many useful results as that of the *elastic fluids.*

I do not here intend to confine myself to the consideration alone of those several substances called gases, and their effects on the animal œconomy, a consideration which, of late, has so much occupied the attention of the faculty, and created so much delight by the simplification and justness it has produced in our notions, and the generalizing of facts. Nor do I mean here to consider the progressive discoveries of different gases, which have been conjectured to contain great medicinal power, and this opinion afterwards as readily abandoned; nor to trace the almost antiquated history of vital air, at one time considered as beneficial in consumptions, and, anon, as a body which could only accelerate the destructive and fatal progress of that disease.

So long as the discoveries of the *elastic fluids* were only insulated facts, so long as physicians, confounded, as it were, by their singular properties, considered each independantly, or were only occupied to determine their respective differences, medicine could only derive some little improvement, some slight change. But the moment that, by an assemblage of multiplied facts, the theory of elastic fluids entirely altered the face of chemistry, when by a severe and more philosophic examination of the chemical phænomena than had ever before been made, a new and important revolution was produced, medicine, as all the other parts of natural history, could not fail to receive bright and unexpected lights. Before this remarkable epoch, before those efforts of genius, which justly placed LAVOISIER as the first chemist in the age, before the united labour of those who have trod in the same glorious path, it was admissible for physicians to rest indifferent upon the improvements which accrued, or even to err in their too hasty application of this science to their art. But the day is now arrived which opens a new career to the whole of physical science, that those thick clouds, which obscured the functions of animated bodies, are chased away by the brightness of the light of *pneumatic* philosophy, when it cannot be disputed, but that medicine, by the accession it has received, has made an advance, which was in vain attempted by experimental philosophy, by mathematics, and all those arts which were enlisted into its service. I do not in the least hesitate to pronounce, that modern chemistry has done more in twenty years for medicine, than all the united labours of preceding ages. Only contemplate before this period, what has been written on the motion of the blood, the blood itself, the nature of respiration, on animal heat, perspiration, digestion, and irritability; examine the subtle and ingenious hypotheses on these subjects, which appear, at this time, so degrading to the human reason; let the immortal Haller be tried by this test, whose facts are so valuable, but whose hypotheses are together a mere mass of dark and futile reasonings, and we shall see how much we are indebted for the new lights thrown in by *chemistry*, and how much we have yet to expect!

It is now no longer permitted to the physician to remain a mute and insensible spectator to the impulse already given to the science of the animal œconomy. No professional man, if he is at all interested in the advancement of his studies, if he is at all animated with a proper zeal for the progress of medicine, can any longer neglect to instruct himself in the conclusions of modern discoveries. The cold statue-like insensibility of some, the affected indifference of others, the sneer uttered by this man, the irritated self-love of the other, the attachment of mankind for the doctrines of their fathers, the hatred of novelty, prejudices of every kind, all the mean passions which glide into society, playing their part on the theatre of civilized life, are to be found also in the career of science; the excesses which these have produced, the pleasantries which they give rise to, the sarcasms, or epigrams, with which they arm discourse, the ridicule which some endeavour to throw on the inventors, the epithet of innovators, of which they are prodigal, all this may retard, for some days, or even for some years, the progress of new ideas, but truth will overcome every obstacle; she cannot be frightened either by the clamours of envy, or the resistance of prejudices, or by the opposition of ignorance. She is the rock against which the impotent billows of human passions are broken. When she strikes with her bright light, spirits sufficiently elevated to support her splendour, she soon inspires them with the necessary power to proclaim her dictates with confidence, so as finally to establish her rights, in vain rejected. The cry still vibrating in our ears against the circulation of the blood and antimony, did not prevent the discovery of Harvey from taking rank among the number of demonstrated truths, and antimony, from being accounted one of the most noble of our medicines, when skilfully administered.

It will turn out the same with the new chemical discoveries, when applied to illustrate the phænomena of the animal œconomy. Its career, so gloriously begun, will never stop; every thing announces a remarkable advancement in its progress begun in our time, and aided by our efforts. If mean talents, lethargic apathy, or irascible self-love, shall again endeavour to retard its steps, their opposition shall vanish, especially by the enegies of the rising youth. Strangers to the tumultuous passion of envy, the new generation, so eager to acquire knowledge, shall be the witnesses and actors in the great *medical revolution*, of which we have only shewed the necessity, and laid the foundation-stone. Like to those great bodies, whose mass and velocity carry every thing before them that comes within the sphere of their action, obliging them to obey their movements, so *the revolution of chemistry*, after having shaken the very basis of the former physical science, will extend its influence over the whole science of nature, and no part will receive a greater and quicker change than the art of healing, which forms so essential a part of natural history.

At the sound of the word *oxygen*, I can readily conceive the effect that this must have on the different classes of mankind.

One circle there is, whom the word *oxygen* affrights, because they have never understood it, and think that the shortest and easiest road is to deny its existence.

Another, angry at a word sounding ill to their ears, without formally denying the existence, refuse it at least all its properties, or those chemical characters, which Lavoisier and his followers have discovered.

A third, more agitated than the rest, murmur at the brilliant part which this plays, and at the oblivion of that principle, which by the mere dint of imagination they made into fixed fire, entering into the composition of bodies under the title of phlogiston.

A yet more numerous circle, and seemingly more temperate than the last, has, however, all the disposition to become the most furious. But this did not arise before *oxygen* was introduced as a *medicine*, before to it was attributed the prerogative of action, and little or nothing to the basis, to which it is found attached. These, astonished to see this intruder admitted as a medicinal matter, examine every feature of its countenance, turn it on every side, and behold nothing but a phantom, which arises from being unaccustomed to its presence, and from not following its steps from its appearance in the world in the month of August, since which time it has been continually claiming fresh attentions from the philosopher.

I need scarce mention another circle of people filled with indifference and apathy, who take no part in this or any other novelty; this crowd, inauspicious at first, ends by being servile, and are to be esteemed neither as friends or foes.

In such a medley, how am I, continues Mons. Fourcroy, to conduct myself with prudence, with that wisdom, with that dignity, which belongs to so important a subject?

Ought I to attack the first argument of my antagonists, and endeavour to persuade them of the existence of *oxygen*, in order to make them see that it possesses the most energetic medicinal virtues?

Ought I to assemble all the facts which prove that those who are averse to believe its virtues, employ it all the while they are denying its existence, and hitherto without doubting of its efficacy?

Ought I to expect that those men who so gratuitously, and with so much good will, admitted of *phlogiston*, would admit of a real existence, weighty and capable of combination, and exhibiting effects very sensible on the animal œconomy?

It is, without doubt, a difficult task; but I feel myself placed under circumstances too imperious not to attempt it. I feel a sufficient hardihood not to despair of success, if I can but obtain a short silence over the prejudices and passions; for without flattering myself that I can speak louder than my adversaries, I am persuaded that my reasoning will be better from the goodness of my cause.

But whilst I am announcing with confidence the hope of a speedy and glorious REVOLUTION in the healing art, I cannot refrain from exposing to view that petulant activity, which instead of merely kindling genius, sets the brain on fire, that unfledged fondness for innovation, which would destroy all that we possess, before any thing is set up in its place. I deprecate that sagacity which would explain all the phænomena of life and disease upon chemical principles. In a word, I desire, without doubt, a REVOLUTION in the theory and practice of medicine, I invoke it with my vows, I have announced it for more than fifteen years past in my lectures, I have proclaimed it, one way or other, in all my works, I will aid it with all my powers, with all my faculties; but I desire a REVOLUTION, wise, slow, and sedate, I do not burn the ancient works with Paracelsus; I do not break any pharmaceutical vessels; I do not proscribe all former knowledge; on the contrary, I would preserve all that does exist, and would even acknowledge that I prefer an empirical practice to the present infancy of chemical medical science. For there are men who desire to build an edifice before they have collected the materials. It is, doubtless, that the animal system in which *oxygen* plays so great a part, may be in fault from either too much or too little of this animating principle; that at the same time it is the source of animal heat, it is also of irritability, and vital and muscular motion; that in applying it either internally or externally, whether in the form of air or otherwise, it, in general, excites the action of life; that we ought to admit of two classes of powerful remedies, the *oxygenating* and the *disoxygenating*, that the first augments all the activity, the heat and circulation, the force and mobility of the system, whilst the second retards all these circumstances; that often in the prudent empiricism of good practitioners, which supplies the defect of philosophic principles, the remedies prescribed, act according to one or other of these powers. But if these assertions, which appear so well founded, due to modern discoveries in chemistry; if this salutary art can already promise itself more important assistance, and a more steady light than has yet guided it, how many things has it not still to desire? How many important problems has it not to propose to chemistry? How many solutions of difficulties has it not to expect, in order for medicine to abandon the path it has hitherto followed, in order to consider all its old foundations as so many errors, and so many chimeras? What a distance there is yet between the first truth which we possess, and that system of facts which is necessary for the formation of a complete doctrine, an entire new system of medicine!

Thus the impulse which I have announced has occurred: and there is no danger that it will either be stopped or diminished. The only obstacle which this MEDICAL REVOLUTION can experience, arises from the fear of its proceeding with too much rapidity, and from its being injudiciously accelerated, by the too fertile imagination of too ardent minds. Scarcely have we explained some few of the functions of the animal œconomy, scarcely have we made some applications of the new *pneumatic* discoveries, scarcely have we entered on the analysis of some of the principal fluids in the human body, and yet there are men who have attempted to class diseases according to the chemical state of the fluids, and to form a *new nosology* *. It has been

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* Fourcroy here probably alludes to a very crude work published by Mons. Baumè, who divides diseases into five classes:

1. *Diseases of Oxygenation* (les Oxigenesés.)—In these the oxygen is either superabundant, or deficient. To the former (les suroxygénesès) belong all inflammations. These arise from cold, in this manner: the air is greatly condensed by cold; and, consequently, during each act of inspiration, more oxygen is taken into the lungs than in temperate, or warm weather. As proofs of the validity of the hypothesis, the author mentions, that the blood of animals, which are made to breathe pure oxygen gas, coagulates much sooner than that of animals which alone breathe common air; and in several patients to whom it was administered, that fluid, the blood, exhibited signs of inflammation. Catarrh differs from inflammation only in a degree; and, therefore, oxygenated muriatic acid gas occasions cough and catarrh. The maximum of combustion, or inflammation, is when the part is too greatly oxygenated, that is, when the inflammation passes to gangrene. Spasmodic affections according to him, greatly resemble inflammation. There are weaker degrees of suroxygenation: but what appears singular is, that chronic spasms belong to the diseases of disoxygenation, and diabetes to those of suroxygenation.

In atonic complaints particular acids and oxyds are formed, which become true morbid causes. From Bonhomme it appears, the rickets arise partly from the generation of an acid, which is similar to the oxalic acid, partly from the deficiency of phosphoric acid in the bones. Phosphat of lime, and phosphat of natron, are therefore the true specifics for this disorder. In scrophula there is a superoxygenation, and in scurvy a disoxygenation of the serum. In chlorosis there is a tendency to acidification in the stomach and secreting vessels.

2. *Diseases of Calorification* (les Calorinèses.)—All active hæmorrhagies, congestions, and ebullitions, belong to the diseases called by the author surcalorinèses; the diseases of debility to the descalorinéses.

3. *Diseases of Hydrogenisation* (les Hydrogenéses.)—To this belong almost all autumnal complaints, bilious fevers, and intermittents; for the

proposed to arrange diseases according to the excess or deficiency of hydrogen, azote, oxygen, or carbon. That which may happen is confounded with what is already

proportion of oxygen in the atmosphere is diminished by the co-operation of heat and azote. The carbonic acid is evolved in smaller quantity from the lungs in warm as in cold weather. The unhealthiness of marshy ground arises from hydro-carbonic acid gas ; therefore hydro-carbon is accumulated in the system, and it shews itself in an overflow of bile. This is the reason why the liver is affected in all diseases of warm climates. According to the opinion of Dr. Beddoes, a mixture of hydrogen gas with atmospherical air is a soft anodyne. Hydro-carbonate, mixed with common air, in the proportion of one-tenth to one-fourth, occasioned giddiness and fainting. *Flatus,* which is either carbonated hydrogen gas, or sulphurated hydrogen, operates in the same manner in the intestines of people who have great nervous sensibility. In these diseases the heat augments to an uncommon degree, because the blood passes much sooner to the state of venous blood, on account of the great quantity of hydro-carbon with which the human body is loaded.

Agreeably to these premises, the author attempts an explanation of the principal phenomena of fever, and its periodical returns.

4. *Diseases of Azotefaction* (les Azoténéses.)—A superabundance of azote in the system gives birth to putrid diseases. Deficient azotization is similar in its effects to the atonic superoxygenation. The author thinks that azotic gas has the power of dissolving miasma : that superazotization is the effect of fever, with this difference, that in inflammatory fevers it does not occur until the end of the fever, but in those of a putrid nature it occurs sooner, and in a greater degree. He is also of opinion, that children have very little disposition to putrid diseases, because they contain little azote. But he here seems to forget, that the confluent small-pox and the putrid sore throat, and aphthæ with putrid symptoms, are frequent diseases of children. The indications of cure in this disease are to oxygenate the human frame.

5. *Diseases of Phosphorization* (les phosphorenéses.)—To this class belong, according to the author, ossification of soft parts, and rickets. The first arises when the phosphat of lime is deposited in soft parts, and the second from the deficiency of the phosphat of lime. Woolaston found the gouty depositions were formed of lithic acid and natron ; a discovery which Hermstadt had also in part made.

From this view of the subject, our readers will easily be able to judge of the spirit with which the whole work is conducted. The Therapeuticodiscovered; it might be said, that such men, calculated to create theories, injure the science of medicine, by a premature application of their opinions, and by their hypothetical results, of which they are not sufficiently qualified to make a prudent and reserved use.

The only remedy which I know, capable of correcting this evil, is to state with precision the point to which *pneumatic medicine* has arisen, and to prevent the confounding that which is only probable with that which is certain. Thus much I hope I have accomplished. My object having been to shew what is certain, what is likely to be discovered, and what is not yet known: and in doing this, I trust, I shall have stimulated, by the relation of great and beautiful experiments, more labourers than there are at present to illustrate this field, which promises such an abundant harvest.

We shall proceed now with the true philosophy of medicine, a phœnix arising out of the ashes of the old

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pharmaceutical Chemistry concludes the whole. From this part we shall give only a few sketches :—

1. *Oxygenating Medicines.*—All these are disoxygenated in the human frame, but with this difference, that some lose their oxygen more quickly than others. In this way the oxyds of iron and quicksilver operate on our internal viscera, and those of lead and silver on our internal surface. The acids also lose their oxygen in the system : and to this cause are to be referred their various medicinal properties. Vegetable diet suroxygenates, and animal food disoxygenates, the body. Spalding observed, that he consumed the air of the diving-bell much sooner after animal, than after vegetable food.

2. *Hydrogenating Medicines.*—Moist atmosphere, bodily rest, fish, fat meat, eggs, and hydro-sulphurs, load the body with hydrogen.

3. *Azotinating Medicines.*—The principal remedies of this class are animal food, and all disoxygenating remedies. The disazotinating remedies are vegetable diet and suroxygenating medicines.

4. *Phosphorating Remedies.*—These are phosphorus, and phosphoric acid, phosphat of lime, and phosphat of natron.

science, with healing on her wings. But in order to well understand the new doctrines of *physiology* and *pathology*, it is necessary to be thoroughly acquainted with some of the recent discoveries in chemistry, which have produced a new æra in this science, as also in medicine.

SECTION II.

THE ANCIENT OPINION RESPECTING OUR ATMOSPHERE.

Fortunately for my readers, the chemical knowledge necessary first to be learnt in order *clearly* to understand the *influence* of *air* on the *blood*, and *thence* on the *animal economy*, comprises the *most beautiful discoveries* in that science; *discoveries* that have done honour to the last century, and this age, and have immortalized the names of Hook, Mayow, Priestley, Lavoisier, Fourcroy, and Cavendish.

The Honourable Mr. Boyle has considered *our atmosphere* as *one large chemical vessel*, in which an infinite number of various operations are constantly performing. In it all bodies of the earth are continually sending up a part of their substance by evaporation, to mix in *this great alembic*, and to float a while in common. Here minerals from their lowest depths ascend in noxious vapours to make a part of the general mass; seas, rivers, and subterraneous springs, furnish their copious supplies; plants receive and return their share; and animals, that by living upon consume this general store, are found to give it back in vast quantities when they die.

The *air*, therefore, which every where presses on us, and upon which we subsist, bears very little resemblance to that *pure, simple, elementary body* generally imagined; and which is rather a substance that can be conceived, than experienced to exist.

Chemistry, however, has made great advances in *this curious research*, and it will soon appear that the composition of atmospherical air has been more *rigorously* determined.

SECTION III.

THE MODERN ANALYSIS OF ATMOSPHERIC AIR;

Or its Separation into 1. VITAL AIR.
2 ELASTIC FLUIDS, 2. AZOTIC AIR.

Chemistry affords two general methods of ascertaining the constituent principles of bodies, the method of *analysis*[*], and that of *synthesis*[†].

When, for instance, by combining *water* with *alkohol*, we form the species of liquor called *brandy*, we certainly have a right to conclude (by this synthesis) that *brandy* is composed of *alkohol* and *water*. And when by distillation of *brandy*, we obtain separate, *water*, and *alkohol* (by this analysis), our evidence of the constituent principles of *brandy* is then rendered complete; and in general it ought to be considered as *a principle* in chemical science, never to rest quite satisfied without *both these species of proofs*.

LAVOISIER'S FAMOUS EXPERIMENT.

This illustrious chemist having placed 83 *grains* of fluid *mercury* in a *retort*, adapted to a *bell glass*, which enclosed 100 *cubical inches of common air*, he kept up in his furnace a constant fire, of such force, as to keep the *quicksilver* almost always at its *boiling point*.

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[*] From the Greek word αναλυσις. The *separation* of any *compound* into its *several parts*.

[†] From the Greek word συνθεσις. The *putting together* the *several parts* of a *compound body*.

On the second day small *red particles* began to appear on the surface of the *mercury*, which gradually increased in size and number for 4 or 5 days.

Convinced that the *calcination* of the *mercury*, after that time did not go on, he extinguished the fire; and when the vessel was cool, he found in his bell-glass, instead of 100 *cubical inches of air*, only 86, and therefore *a loss* of 14 *cubical inches* of *air*.

Now, 14 *cubical inches* of *air* weighs 7 *grains*, and the *red particles* or *calx of mercury*, being carefully collected, weighed 90 *grains*. The *mercury*, therefore, by being calcined, had required an *increase of weight* of 7 *grains*, the *exact weight* of *air* which seemed *lost**.

The 86 *cubical inches* of *air* remaining in the glass after this calcination was ended being examined, it was found to possess *these distinguishing properties*.

An animal being put into it was *suffocated* in a few minutes,—and when *a taper* was plunged into it, it was *extinguished*, as if it had been immersed in water †.

This gas, or *air*, has been called *phlogisticated air*, *non-respirable air*, *noxious or mephitic air*, *impure air*; but the French chemists have preferred the term *azotic gas (lethal air)* from the Greek words α, *privative*; and ζωη, *life*, as *this air* so quickly destroys life.

LAVOISIER'S SECOND EXPERIMENT.

Having taken 90 *grains* of the *calx of mercury*, the product of the *last process*, Lavoisier put it into a glass retort fitted to a proper apparatus for receiving aerial products.

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* The conclusion is obvious, and in the next experiment we shall find, that the 14 *cubical inches of air*, which was *absorbed* by the *mercury*, and converted it to a *calx*, was the *vital* or *respirable part* of our air.

† Not from any peculiar property of its own, but because the *vital* or *respirable part* was abstracted from it, as will be seen from the next experiment.

Having applied a *much stronger heat* than in the former experiment, he observed that at first, in proportion as the *calx* of *mercury* became heated, the intensity of its colour augmented; but soon after the *calx* began gradually to decrease in bulk, and in a few minutes *its red colour altogether disappeared*, and the 90 *grains of calx of mercury* was converted into the 83 *grains of running mercury*, and 14 *cubical inches* of an *aerial fluid* passed over into the recipient.

Now these 14 *cubical inches* of air weighed 7 *grains*, the *exact weight* of the air *consumed* by the *calcination* of the *mercury* in the first experiment*; and the 83 *grains* of the *calx* of *mercury reduced* † to a *metallic state* being examined, had *lost in weight* 7 *grains*, the *exact weight* of the air now obtained. *This air* possessed these *peculiar properties*.

An animal being placed in *it*, became *remarkably lively*; a *taper* burnt in it with a *dazzling splendour*; and *charcoal*, instead of consuming quietly away, as it does in common air, burnt *with a flame*, attended with a decrepitating noise, and threw out such a *brilliant light* that the eyes could hardly endure it.

This species of air was *discovered* almost at the same time by Dr. Priestley, Mr. Scheele, and Lavoisier. Dr. Priestley gave it the name of *Dephlogisticated* or *Pure Air*; Mr. Scheele called it *Empyreal Air*; and Lavoisier first named it *Highly respirable Air*, or *Vital Air*; and afterwards, as it forms acids, by combining with certain bodies, he adopted the term *Oxygen Gas (Acid-making Air)*, from the Greek words υξυς, *sour*; and γεινομαι, *to beget*[*].

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* Had the 100 *cubical inches* of atmospheric air contained a larger share of *oxygen* or *vital air*, *more mercury* would have been *calcined*. For *calcination*, as this experiment shews, is nothing more than the *combination* of *vital air* with *any metallic* body.

† From the Latin word *reduco, to bring back*. *Reduction* is the bringing back a *metal converted into a calx* in its *pristine state*.

Lavoisier then repeated the same experiments, as before related, and *re-combined* the 2 *elastic fluids*, which he had separately obtained in the two experiments of *calcination* and *reduction*, viz. the 84 *cubical inches* of the AZOTIC AIR, and the 14 *cubical inches* of the OXYGEN AIR, and he produced from *this combination* an *elastic fluid precisely similar in all its properties to atmospheric air*, contributing in the same way to a repetition of the same experiments, and possessing the same power of supporting animal life, and combustion.

The philosopher can have no remaining doubt as to the *composition* of *atmospheric air*: but the circumstances of these experiments might appear to him *more correct*, though probably at the time *less clear* to others, were it said, that *mercury*, at a certain temperature, overcoming the affinities[†] of *caloric* [*] and *azotic air* for *oxygen*, attracts and fixes within itself *oxygen* [†], (the *base* of oxygen air, for oxygen air is oxygen combined with a certain quantity of caloric :) —hence its *increase of weight*, and its *conversion into an oxyd or calx*, and hence the *azotic*, or *lethal*, *air left us* in the bell-glass.—That the temperature being increased [‡], the affinity of the *caloric* for *oxygen* becoming now superior to the attraction of the *mercury*, the *oxygen* is withdrawn from the *oxyd of mercury* by the superior attraction of the *caloric*; hence its *decrease in weight*, and its *restoration to fluidity and splendour*, and hence the produce of

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[*] If *sulphur* or *charcoal* be burnt in *oxygen* or *vital air*, in a close vessel, and the fumes be condensed in water, *this water* will acquire an *acid taste*, and be increased *in weight* exactly *corresponding* to the *weights* of *sulphur* or *charcoal* consumed, and *that* of the *oxygen air* destroyed. *Sulphur* united thus with *oxygen*, the fumes being collected in water, will form *vitriolic acid*; and *charcoal* combined with *oxygen*, and diffused in water, will form the *carbonic*, or *aerial acid water*.

The *calces* of metals the French chemists call *oxyds*, which signifies a body impregnated with a *certain quantity* of *oxygen*, but not *sufficient* to render it *perceptibly acid*.

[†] If you take a bullet and divide it with a knife into *two parts*, provided these be smooth and rubbed together, they will strongly unite and form *one whole*. This is from a law impressed on matter called the *attraction of cohesion*. But should a particle of sand, or any roughness exist, the particles being divorced from each other, beyond the *sphere of mutual attraction*, they are no longer actuated by this law.—*The attraction of cohesion* in *mercury*, at the common temperature, hinders the admission of *oxygen*, for which it has an *elective attraction* or *affinity*. But when exposed to a strong heat, the *caloric* expands this fluid; that is, insinuates

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itself through the body, and separates its particles (thermometers depend on this expansive power of fire), and, like the pieces of the bullet where sand interposed, the divided particles are no longer subject to the *law of cohesion*; then it is they obey the *law of attraction*, and each atom of *mercury attracts to itself* a particle of *oxygen*, just as a loadstone would draw to itself a particle of iron.—The loadstone *only attracts* iron. This represents the term *affinity* in chemistry. The mercury did not attract the *azot*, because chemists would say it had no *affinity* for it.

[*] *Fire*, or the *matter of heat.*

[†] An experimentalist would illustrate this by placing a *needle* between *two magnets* of different powers. This would represent oxygen between the two attractions of the *caloric* and *azotic air*. As we may suppose a *loadstone* to have an attraction for the *needle* superior to the *two magnets*, so would it draw *the needle* to itself from *these*, just as the *mercury* draws away from the *azotic air* and *caloric*, the *oxygen*.

[‡] This is a curious fact; the temperature being increased, the *caloric alode* overcomes the elective attraction of *mercury* for *oxygen*, and depriving it of *that principle*, the *attraction of cohesion* takes place with the particles of *mercury*, and we obtain then *running mercury* and *oxygen gas*. To have recourse to the note † page 69, the *oxygen* and *mercury* being separated beyond their *sphere of attraction*, the *caloric* attracts to itself *oxygen*, just as either of the *magnets* (in the preceding note) would again attract to itself the *needle*, were it placed within its *sphere of attraction*, but *beyond that* of the *loadstone*.

oxygen, or *vital, air,* clearly displaying to us this important truth :—

> " *That atmospheric air is actually a compound of two*
> " *heavy substances, azot* and oxygen*†; *which bodies,*
> " *when combined with caloric, or the matter of heat, are*
> " *aeriform, and may be procured in separate states,* viz.
> " *in the condition of vital and azotic, air, which being mixed*
> " *in a certain proportion constitutes our atmosphere* ‡."

SECTION IV.

THE ANALYSIS OF OXYGEN AIR.

That *oxygen gas* is composed of
1. OXYGEN,
2. CALORIC,
3. and LIGHT,

will be *evident* from the following very elegant experiment made by the celebrated Dr. Ingenhousz.

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* That *azot* is a *solid substance* as well as *oxygen,* can be easily proved by experiment, consult page 67. That the application of heat should render *oxygen* and *azot gaseous,* is not wonderful, since we often observe *ice* by the admixture of *caloric* rendered a *fluid,* and heated to 212, converted into an aeriform and transparent gas. The hardest substance in the world, the *diamond,* may be volatilized in the same way. Mon. D'Arcet took a sphere of porcelain china, and after cutting it into halves, confined a *diamond* in the middle ; he then joined the two sections strongly together. Putting these balls into a furnace, he afterwards unscrewed them, and found the diamonds evaporated, and the place which they occupied empty, though he could perceive no chink or fracture any where over the surface of the ball!

† The distinction betwixt air and vapour is this, both are formed of *particles* held in suspension by caloric, or heat, but by cold, or condensation, vapours return to their original form, whereas *airs* continue *permanently elastic.*

‡ In our climate the proportion generally is 3 of *azotic air* to 1 of *oxygen air,* as will be hereafter proved.

A fine *iron wire,* twisted into a spiral[*], being heated at its extremity red hot, and thrust into a jar containing only *oxygen air,* it instantly took fire, and burnt away rapidly[†], exhibiting a bright light similar to that of Chinese fireworks, throwing out brilliant sparks, which fell to the bottom in the form of round globules[‡].

At the beginning of the combustion there is a slight augmentation in the volume of the air in the bell-glass, from the dilatation caused by the caloric or heat; but presently after a *rapid diminution* takes place, and *the mercury rises in the glass,* insomuch that when the *quantity of iron is sufficient,* and the *oxygen air operated on is very pure,* almost the *whole air employed is absorbed*[§],—or should the *quantity of iron be insufficient,* the *remaining air unabsorbed* will be found *perfectly pure vital air*[||].

The *theory* of this experiment is the same as the last. At a certain temperature *iron* has a *stronger affinity* for the *oxygen,* than *caloric* and *light* have. It *therefore* attracts to itself the *oxygen,* and *caloric* and light becoming disengaged ¶, are rendered *active* and *evident* to the senses.

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[*] This was done to render the experiment more striking.

[†] This experiment shews that *azotic air* retards the union of *oxygen* with bodies attracting it, which in some cases altogether prevents it.

[‡] These were found floating on the mercury, and are natural *Martial Æthiops.* How much slower is the *calcination* or *rusting* of *iron* in other circumstances!

[§] That is, if 100 *grains* of *iron* be consumed in 70 *cubic inches of oxygen air,* the whole volume of air will disappear; and as 70 *cubic inches* of *oxygen air* weigh 35 grains, the 100 *grains* of *iron* will weigh, in its state of *oxyd* or *calx,* 135 grains.

[||] As *pure* or *oxygen air* is found unaltered, the *mephitic air* left us in the *calcination of the mercury* could arise only from the *abstraction* of the *oxygen air.*

The burning of all bodies is then nothing more than the *decomposition* of *oxygen air.* It is the *air*, therefore, and not the combustible body, that gives out *light* and *heat.*

When we are sailing on the water in a still day, *distinct objects appear to meet us*, but our reason corrects the delusion. When we behold the sun, moving from east to west, philosophy again assumes its empire, and we are convinced it is *stationary.* If we take a *prism*, it displays to us a variety of colours; our reason tells us here also, that *these colours* arise from the *rays of light*, and are not *in the prism*,—so of the combustion of bodies, the *caloric* and *light* are not from *the wax* of our candles, but from the *oxygen air*, which, as we have seen in the above experiment, becomes, under certain circumstances, *decomposed.*

SECTION V.

THE SYNTHESIS OF WATER;

Or its formation from its 2 CONSTITUENT PARTS, { 1. HYDROGEN. 2. OXYGEN.

Water and *air*, says Sir Isaac Newton, composed of old worn particles and fragments of particles, would not be of the same *texture* and *nature* now as at the beginning, did not the *primitive principles* of *matter* continue *entire*, and *compose bodies* of *one* and the *same nature and texture in all ages.* The *changes* of *corporeal things* are to be placed *only* in the *various separations* and *new associations* of *these parmanent particles.* OPTICS, page 376.

¶ As the calcination of the *mercury*, in the first experiment, lasted several days, the *disengagement* of *caloric* and *light* was extremely small for each particular moment of time, and therefore not perceptible to the sight. The heat, also, of the furnace was confounded with it, which made it necessary to relate Dr. Inghenhousz's experiment, where *the combustion* of the metal was more rapid, and unconnected with any furnace.

Previous to our entering upon the subject of the effects of air on the animal economy, it will be necessary to shew, also, that *water*, though it be the solvent of a vast variety of bodies, is neither that *compound* or *simple element* formerly supposed, but made up of two *very distinct* and *different principles.*

The new and beautiful doctrine of the French chemists, respecting the composition of *air*, the nature of *combustion*, *calcination*, &c. was daily gaining ground, and obtaining the applause of every one, when an experiment performed by Dr. Priestley made it for a while totter on its basis.

In the middle of a long glass tube this great experimentalist put some *calcined lead*, and affixed to the extremities *bladders* which were filled with *inflammable air* *.

Having applied a strong heat to the middle of this tube, he next squeezed the bladders, and forced the *inflammable air* along the tube.

The *inflammable air* soon disappeared; no *oxygen gas* was evolved: but the *red lead* quickly *reassumed* its original metallic splendour.

A question then arose, whence *this property* in *inflammable air* which the *antiphlogistians* would ascribe to the evolution of *oxygen gas* †.

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* *This air* Dr. Priestley obtained from *diluted* vitriolic acid poured on iron. *Iron* was therefore said to contain a great quantity of *this air.* But the fact will soon appear that the air arose from the *decomposition of the water* mixed with the vitriolic acid. *Inflammable*, or *hydrogen air*, being 15 times lighter than common air, it is employed for balloons.

† *Inflammable air* quickly destroys life, whereas *oxygen gas* appears to be the very principle of life. *It* is considerably lighter than either *oxygen* or *common air*. *It* explodes when it comes into contact with *common air*, but more especially with *oxygen air*, provided any body in actual inflammation be present. The difference therefore between these two airs is great.

The favourers of the new system were not able to deny the fact; and as the *inflammable air*, which was now called *phlogiston*, had in this experiment *disappeared*, they found some difficulty to persuade *the supporters of the old doctrine* that the *revival of the metal* could not be from the *absorption* of the *inflammable air*, as the *red lead* had *lost* a good deal of its *weight*, and the *effect* of an *addition of matter* (if *inflammable air* be *matter*) could be no other than to give it *an increase* of *weight*.

Fortunately for chemistry the Honourable Mr. Cavendish by passing an electric shock through *oxygen air* blended with *inflammable air*, produced water *. *The reduction* of the *red lead* in Dr. Priestley's experiment was then no longer a matter of surprise. At a *certain temperature* the *inflammable air* overcoming the attraction of the *lead* for *oxygen* divorced it of *that principle*, and uniting with it formed *water*.

THE ANALYSIS, OR

Its separation into { 1. HYDROGEN AIR,
2. and OXYGEN AIR.

But that no doubt may be entertained on this head, I must beg leave to relate an experiment which was performed by Meusnier before a large assembly of the Academy of Sciences at Paris.

He took a *gun-barrel*, into which he put some thick pieces of *iron-wire* flattened by the hammer. He *weighed* the whole with a scrupulous exactness. He then *luted* the gun-barrel to secure it from the immediate contact of the fire. It was then placed in *a furnace*, but so *inclined* that water would readily glide down it. He adapted to the upper extremity a *funnel* containing water, from which it could not escape into the gun-barrel but drop by drop. This funnel was *closed at the top* to avoid any the least evaporation of the water. At the lower extremity *vessels* were adapted to receive any aerial product. To use every precaution *these* were exhausted of their air.

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* 85 grains, by weight, of *oxygen air*, and 15 grains of *inflammable* or *hydrogen air*, produced here precisely 100 grains of *water*. In this experiment *caloric* is disengaged, and the 85 parts of *oxygen* and 15 of *hydrogen* unite, which, being naturally *solid substances of themselves*, become, if nearly all the *caloric* be extracted from them, *ice*: if less, *water*.

The *gun-barrel* was now made red hot, and the *water* from the funnel passed into it drop by drop.

An astonishing quantity of *inflammable air* * was quickly obtained.

Having removed the luting, the *gun-barrel* with its *contents* weighed considerably *heavier* than *before*; and *the acquired weight* of the gun-barrel being *added* to the *weight* of the *inflammable air* thus produced, was *precisely* the *weight* of the *water expended* in the process: and the *iron-wire* found in the barrel (the process being over) resembled in every respect *iron* that has been consumed in *oxygen air*, that is, it was become an *oxyd of iron*, which accounts for the *oxygen*, the other constituent principle of water.

Another proof that *water* is composed of *hydrogen* and *oxygen* may be drawn from the celebrated experiment of Mr. Watt. This illustrious chemist wet powdered charcoal, and put it so moistened into a retort. Fire being ap-

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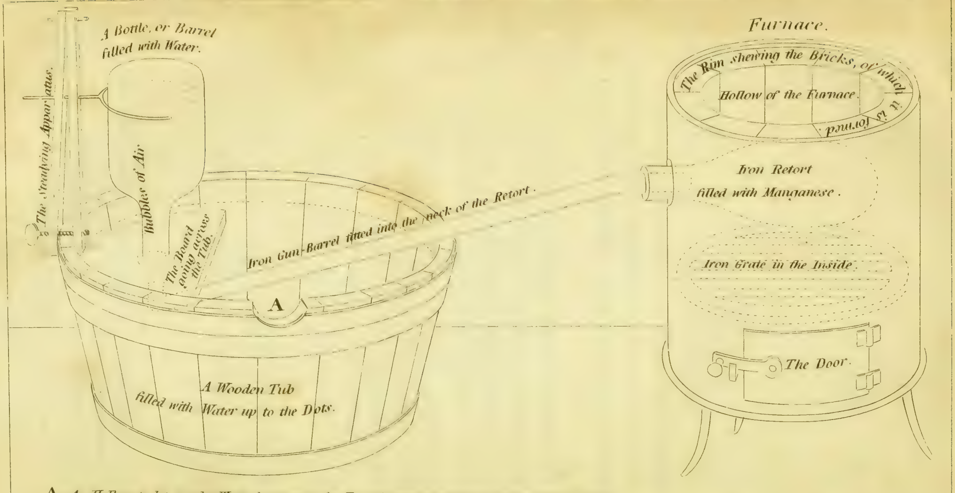
* This *inflammable air* was generated from the *hydrogen* of the water, which united with the *caloric* of the furnace in its passage through the barrel. *Inflammable air* the French chemists call *hydrogen gas*, from the Greek words ὕδωρ *water*, γεινομαι *to beget*.

Mr. Watt's Apparatus, for making of Air; as simplified by Dr. Thornton.


A Bottle, or Barrel filled with Water.
The Steadying Apparatus.
Bubbles of Air
The Board going across the Tub.
Iron Gun-Barrel fitted into the neck of the Retort.
A
A Wooden Tub filled with Water up to the Dots.
Furnace.
The Rim shewing the Bricks, of which it is formed.
Hollow of the Furnace.
Iron Retort filled with Manganese.
Iron Grate in the Inside.
The Door.

A. An Hollow to let out the Water by means of a Trough, communicating with an empty Tub.

plied, *hydrocarbonate air* * is soon formed; that is, *hydrogen air*, or *inflammable air*, mixed with fixed air, which, in the next section, we shall find is composed of charcoal and *oxygen*.

SECTION VI.

THE ANALYSIS OF CARBONIC ACID AIR, OR FIXED AIR;

Or its separation into its 2 CONSTITUENT PARTS, { 1. CHARCOAL,
2. OXYGEN AIR.

Mr. Tenant, a famous chemist of Emanuel College, Cambridge, having procured a glass tube hermetically sealed at one end, luted it over with clay and sand to prevent the sudden action of the fire. He then introduced into it some *phosphorus* and powdered *marble* †, and having closed the open extremity, he applied to the tube a quick heat, and the result was, when cold,

1. *Phosphoric acid* ‡ combined with *calcareous earth*.

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* This air, which is applied medicinally, was the happy discovery of Mr. Watt. It is made by kneading of charcoal and water together, and using the retort in the manner employed for obtaining *vital air*. The apparatus wanted to make *vital air*, is a furnace, in which is placed an iron retort filled with finely powdered *manganese*. An iron gun-barrel enters the mouth of the retort, and at its other extremity is connected with his *pneumatic receiver*, or with any vessel filled with, and immersed over, water. The furnace is then filled with charcoal and lighted, and *vital air* is obtained very rapidly, and in considerable quantity. The luting that Dr. Thornton discovered to be the best is glazier's putty mixed with sand.

† If *vitriolic acid* be poured on *marble*, *fixed air* is given out in great abundance. Mr. Tenant therefore assumes this data, *that marble contains fixed air*. As the residue is *vitriolic acid* and *calcareous earth*, *marble* is known also to contain *calcareous earth*.

‡ *Phosphorus* and *oxygen*. The answer to this natural question,—*Whence this oxygen?* is clearly demonstrated over leaf.

2. *Phosphorus* combined with the *same earth.* And,

3. A *black substance*, which differed in nothing from *charcoal* made from vegetables.

If *vitriolic acid* * be poured on *marble*, *this acid* possessing a superior power of combination or attraction for the *calcareous earth* of the marble, than the *carbonic acid* † has, it unites with the *calcareous earth*, and the *carbonic acid*, becoming disengaged, attracts to itself *caloric* ‡, and escapes in the form of *gas* §.

Marble is therefore a compound of 3 *bodies*,
1. *Oxygen*, combined with
2. *Charcoal*, or the *carbonic acid*; and,
3. *Calcareous earth.*

The *theory of* Mr. Tenant's *experiment* will be now easily understood.

At a certain temperature *phosphorus* (which is a simple body) overcoming the attraction of the *charcoal* for *oxygen*, deprives the *carbonic acid* of its *oxygen*, and becomes, in consequence,

1. *Phosphoric acid* ‖, which unites with the *calcareous earth.*

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* *Sulphur* and *oxygen.*

† *Charcoal* and *oxygen.* *Fixed air* is *charcoal*, *oxygen*, and *caloric.*

‡ The *caloric* proceeds in part from the *vitriolic acid;* which acid, if poured on *water*, will almost make it *boiling hot*, to the no small astonishment of persons unacquainted with chemical operations. Since *two cold bodies*, coming into contact with each other, give out *heat*, *caloric* we see may be in a *dormant* or *neutralized state*, and that in condensation of oxygen into bodies, only a part of the *caloric* is disengaged from the vital air.

§ Viz. *Carbonic acid gas, or fixed air;* which is *charcoal* (carbon), *oxygen*, and a certain quantity of *caloric.*

‖ *Phosphorus* and *oxygen.*

The *phosphoric acid* being *saturated* [*] with the *calcareous earth*, we have also,

2. *Phosphorus* united with *calcareous earth.* And,

3. The *charcoal* of the marble is left in its *simple state* [†].

The proof, however, by synthesis, that the constituent principles of *fixed air*, are *charcoal*, and *oxygen air*, is more beautiful, as being easier understood.

THE SYNTHESIS,

Or union of the { 1. CARBON,
2. and OXYGEN AIR.

This *charcoal* [‡] Mr. Tenant then burnt in *oxygen air*, which was converted into an *acid gas*, whose *weight* equalled the sum of the *weights* of the *charcoal* which had been burnt, and the *oxygen air* employed.

Fixed air, or the *carbonic acid air*, is composed of 28 parts of CHARCOAL to 72 of OXYGEN AIR; or, in other words, 144 cubic inches of *oxygen air* will saturate or take up 28 grains of *charcoal*.

This acid gas had all the *properties* of *fixed air*. It was readily upon agitation *imbibed by water* [§], which acquired the sparkling appearance and taste of Pyrmont and Seltzer water. *This acidulated water* dissolved iron filings, and became a perfect chalybeate water. *This air*, like *fixed air*, weighed *heavier* than *common air*. A *candle* being put in it, was quickly *extinguished*, and *an animal* died *convulsed in it.*

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[*] If *diluted vitriolic acid* be poured on marble, an effervescence denoting the extrication of *fixed air* is seen; when the union of the *vitriolic acid* and *calcareous earth* is *complete*, it is said to be *saturated*, the effervescence now ceasing.

[†] The *oxygen*, with which it was before combined, being separated from it, by the *superior attraction* of the *phosphorus*.

[‡] *Any charcoal* would have given the same product.

[§] We owe our first knowledge of *fixed air* to Dr. Black, but that *water* absorbed *this air* upon agitation, and was made Seltzer or Pyrmont water, and that if *iron filings* be put into *this acidulated water*, it becomes a *chalybeate*, we are indebted to the happy industry of Dr. Priestley.

Having sufficiently explained the chemical composition of substances that have a most important part to perform in the animal economy, (as will be presently seen) we will now proceed to the consideration of the other properties of atmospheric air.

SECTION VII.

OF THE WEIGHT OF THE AIR.

As light as air, is an expression made use of in common conversation, yet it is much heavier than is commonly imagined. We have numberless proofs of its weight, many of which though the ancients could estimate as well as we, yet they considered it as a substance totally void of gravity, and called it an element. An element was different from earthly matter, and therefore they considered it as wanting ponderosity. However all material substances, of which air is one, have weight; like other bodies it falls to the earth, and is more dense as it approaches its centre. Every one knows that air on the tops of high mountains is much rarer and thinner than it is below in the valley; if any should doubt it, the difference they will find in drawing their breath in the different places will soon convince them. As they go up a very high mountain their breathing becomes quicker, the atmosphere becomes clearer, neither clouds nor vapours are able to rise to such heights, and therefore as he ascends the traveller leaves the tempest and the storm midway below him. Ulloa, who went to take the measure of a degree upon the Andes in Peru, which are the highest mountains in the world, tells us, that when clouds gathered below the mountain's brow while he stood on the top, they seemed like a tempestuous ocean all dashing and foaming beneath him, here and there lightnings breaking through the waves, and sometimes two or three suns reflected from its bosom. In the mean time he enjoyed a cloudless and serene sky, and left the war of the elements to the unphilosophical mortals on the plain below him.

Such appearances as these, with which the ancients might be as well acquainted as we, should have led them to consider the air as having weight; but they were not at this time acquainted with a machine which serves to discover its weight by proofs much better calculated for conviction than those brought from untried nature. The machine I mean by which we so plainly discover the weight of the air, is the *air-pump*. For the first invention of this, the world is indebted to Otho Gueric, a German: but it was our countryman Boyle who turned it to real use, it was he who improved it, and applied it to philosophical purposes. In the hands of Gueric it was a mechanical instrument; in those of Boyle it was a truly philosophical machine. By it we can with ease empty a glass vessel of its air, and put what bodies into it we think fit. Thus comparing the changes wrought upon bodies by being kept from air, with the same bodies when exposed to air, we come to a precise knowledge of the effects of air upon bodies in general.

By means of this instrument the first thing we learn is, that the air is actually heavy. If a vessel be by means of the air-pump exhausted of its air, if we clap the palm of our hand to its mouth we shall quickly perceive the weight of the air upon the back of the hand, pressing the hand in a manner into the vessel. If a part of the skin of a bladder should be placed there instead of the hand, the external air would break the skin with great force, and rush into the vessel with a noise. If the air be pumped out of a square glass vessel, the weight of the external air will break the glass into shivers. But to put the air's weight past all doubt, we can actually weigh it in a balance, and it is there found heavy.

Having exhausted the air out of a thin glass flask, and suspended it at one end of a balance, which being nicely counterpoised by weights in the other scale; this done, admit the air into the flask, into which it will rush with a noise, and though the flask was balanced before, it will now upon the admission of the air become heavier and preponderate. If the flask holds a quart, it will be found that the weight of the air it now contains is about seventeen grains above what it was when quite empty, so that a quart of air weighed upon an average in the open air, is about seventeen grains.

Now, if a single quart of air weighs so much, what would not a pillar of air weigh, the base of which rests upon earth, and whose top reaches several miles above the clouds? The weight of such a pillar, how extraordinary soever it may seem, can be determined with the nicest precision. We mentioned just now with what extreme weight such a pillar rested upon the back of the hand which had no air under it to keep it up, or balance the weight above it, but we cannot precisely tell how great that force is as yet. Let us go a little farther then, and see with what weight this high pillar of air would press upon the surface of a tube of quicksilver. Let us suppose a long glass tube exhausted of all air, and stopped close at the top, to be plunged at the other end into it.

It is evident that the air will press upon the surface of the quicksilver without; and if there were air in the tube, it would press upon the surface of the quicksilver within the tube also: but there is no air at all, as was said, within the tube, for that was exhausted before the experiment; so that in short all the air will press upon the quicksilver on the outside of the tube, and none upon that within. The air, therefore, as it has great weight, will press the external surface of the quicksilver all over, and drive it up into the hollow of the tube, where there is no pressure from air at all. As if I pressed down the palm of my hand upon water, the water would rise up between the interstices of my fingers where the pressure was least: by means of this pressure of the heavy air upon the quicksilver, the quicksilver will be driven up into the tube, and rise in it, if the tube be long enough, about twenty-nine inches and an half high.

Thus then the air presses down with a weight capable of making quicksilver rise to twenty-nine inches and an half. A pillar of air therefore that reaches to the air's greatest height, is just as heavy as a pillar of quicksilver of the same diameter that measures exactly twenty-nine inches and an half. For the weight of the air pressing down must be just exactly equal to the weight of the quicksilver that is pressed up. When one body raises another to its highest pitch, and can raise it no more, the body raised then equals the body raising. We may therefore boldly conclude, that a pillar of air which reaches from the top of the atmosphere, weighs just as much as a pillar of quicksilver twenty-nine inches and an half high. The weight of such a pillar we can easily estimate, and consequently measure the weight of the atmosphere; but first let us mention another case similar to this of the quicksilver, which is water.

If by any means we exhaust all the air from a vessel more than thirty-two feet high, and stopping one end, set the other in water, the water will rise thirty-two feet within the vessel and no higher, for the weight of the air will press upon the surface of the external water as it did before upon the surface of the quicksilver, and press up the one as well as the other with all its weight. A pillar of water of thirty-two feet high just weighs equally with a pillar of quicksilver twenty-nine inches; the air therefore presses up that thirty-two feet, as it pressed up this twenty-nine inches. The weight therefore of a pillar of the atmosphere is equal to either a pillar of quicksilver twenty-nine inches high, or to a pillar of water thirty-two feet high; it is equal to either, for they are equal to each other.

I shall mention an obvious experiment to this purpose, which the student can put into practice without any apparatus while at tea. Some water being poured into a saucer, let him burn a bit of paper in a tea-cup, which will rarefy and exhaust and make a vacuum in the cup. Then while the paper is yet burning, let him turn it down paper and all into the saucer, and the air without will press the water up from the saucer into the cup. The water will stand within the cup in a column, and if the cup were thirty-two feet high, and the air within it perfectly exhausted, the water would rise so high in it, as we have said before.

If what has been said is well understood, the student will be at no loss to account for the rising of water in *pumps*, or the standing of the quicksilver in the *barometer*.

All these appearances in nature are performed, as was said, by the weight of the air pressing the fluid into places where there was no air, nor any other resistance. But though these truths are now so obvious as they are astonishing, yet for many ages the causes of the ascending of water in pumps was utterly unknown. Philosophers were content with thinking after Aristotle, and his opinion was, that Nature hated a void or empty space, and therefore made all possible efforts to fill it when the art of man had made one. All this may be very true; but we want to know, why nature hates this void? And here their philosophy was puzzled. Torricelli was the first who undertook to explain, as we have seen, why Nature made haste to fill up this void. An accidental experiment put him into the right road towards the discovery. Having filled a tube, which was stopt at one end, with quicksilver, and then fixed this tube with its open end in a tub filled with the same: the quicksilver in the tube did not all descend into the tub, but stood in the tube at the height of twenty-nine inches and an half. This experiment was soon communicated to the learned of Europe; the genius of the times all over Europe was then employed in quest of new discoveries; Boyle, Paschal, and Riccioli, set themselves to consider this new phænomenon; and this led them to the following conclusions. "Water rises in a void thirty-two feet high, as we have for ages seen in pumps; quicksilver stands twenty-nine inches high, as we see in this new experiment; a pillar of the one weighs exactly as much as a pillar of the other; the ascent of both therefore must be ascribed to one and the same cause. And why may not this cause be owing to the pressure of a pillar of air? And if the pressure of this pillar of air were taken away, would the quicksilver then stand in the tube? Let the Torricellian tube, vessel, quicksilver, and all, be placed under the glass of the air-pump, and let the weight of the air be taken away from the quicksilver; it will then be found to stand no longer suspended in the tube, but will sink down to the same level with the rest of the quicksilver in the vessel in which it is placed." This was enough, and indeed fully sufficient to convince them, they pursued the track of light where it led, and at length they deduced a theory of the air equally clear and convincing.

We mortals, who are upon the surface of the earth, said they, resemble fishes at the bottom of the ocean: like them we are enveloped in a fluid of air, which rises far above our heads, an ocean of atmosphere, which while on earth we cannot quit. This atmosphere surrounds our whole earth for some miles high, enveloping the earth on every side. Let us suppose the tops of the highest mountains thrusting up their heads through this great fluid, like rocks in the ocean that almost rise to, but not quite so high as the surface. As the parts of this ambient atmosphere are all heavy, they press down one upon another, and those parts that are lowest will suffer the greatest pressure, as they have the greatest number of parts above pressing them down. The lower vallies will, therefore, suffer greater pressure from the atmosphere than the higher mountains. Let then the Torricellian tube be brought into a low valley: here the pressure upon the quicksilver will be greatest, and it will rise above twenty-nine inches and an half. Let it be now brought up to the top of an high mountain: here the pressure will be least, and it will sink down proportionably. On the summit of Snowdon-hill, Dr. Halley found the barometer above three degrees lower than at the bottom. On the summit of an Alpine mountain, the Abbe Nollet found it a quarter less high than on the plains of Piedmont. Thus therefore the tube of Torricelli, by the quicksilver rising or falling, will serve very exactly to measure the weight of the air.

As the quicksilver in the tube sometimes in the same place stands an inch or two higher, and sometimes several inches lower, than twenty-nine inches and an half, it is very plain, that the air is sometimes heavier and sometimes lighter: that when heavier, it presses up the quicksilver above twenty-nine inches; when lighter, the quicksilver suffering less pressure rises not so high,

The tube therefore will exactly determine these variations, and its heights will alter with every change. This instrument was first called the Torricellian Tube; but being now made use of for measuring the alterations and weight of the air, it is called the *Barometer*, or Weather-glass. The simplest, and perhaps best method of making the barometer is thus: a glass tube, of about thirty-five inches, hermetically sealed at one end, is to be filled with quicksilver. Hermetically sealing a glass is no more than holding the end in the flame of a candle, or fire, until the glass softens, and then twisting it round, so as quite to close up the orifice, it being first filled with quicksilver well purged of its air, which is done by boiling the quicksilver in water. The finger being then placed on the open end, this end is set into a bason of the same prepared mercury. Then upon removing the finger, the mercury in the bason will join with that in the tube, and that in the tube will sink down to about twenty-nine inches and an half, one time with another. Instead of the bason at the bottom, the lower end is usually turned up, and dilated into a sort of cup, containing a quantity of quicksilver; upon which the air presses, and so drives it up along the bend of the tube to the usual height. This tube thus fitted and filled is then fastened to a board, which has the inches marked upon it; and towards the top those inches are divided into their parts, in order to measure the rising and falling of the quicksilver more precisely.

An instrument contrived in this manner will pretty nearly serve to measure the weight of the atmosphere; it will not precisely measure its weight, because it is affected also by another property of the air, namely, its elasticity or spring, as we shall see in its proper place. By this instrument we learn, that the air is changing its weight continually, being sometimes more heavy, sometimes more light; but upon an average, its weight (and spring together) are able to press up a pillar of quicksilver twenty-nine inches and an half high, or a pillar of water thirty-three feet high.

What we have now seen with regard to pumps, we may every day see practised in a smaller degree by the common syringe. If one of its ends be put into water, and the piston be drawn up, this will make a space void of air, and the water will be pressed up into the void, and thus fill the syringe.

When children suck at the breast, it is by natural mechanism somewhat resembling that of the syringe; for the child draws into its lungs the air in his mouth, then stops its entrance by the nostrils, and next squeezes the nipple between its lips, so that no air can come that way. Thus there is a void in the mouth, and the external air pressing upon the mother's breast, squeezes the milk into the infant's mouth, and by this means it finds the nourishment proper for its support.

Cupping-glasses may be explained upon the same principle. That part of the body under the mouth of the glass has no pressure of air upon it; for the air was driven out of the glass by heat, before the glass was applied. The flesh of the body is raised to that place where it finds least resistance.

The atmosphere thus pressing down upon the surface of the earth envelopes all the bodies upon its surface, and presses them together. The whole earth may be considered to suffer as great a pressure from the atmosphere, as if it were pressed on every side by water thirty-three feet deep; and all that are upon the earth's surface are as much pressed on every side as we would be, if instead of an airy atmosphere we had an atmosphere of water, like fishes, thirty-three feet above our heads. The weight of such an atmosphere of water can be easily calculated. A cubic foot of water we will suppose to weigh 60 pounds, 33 feet will weigh 33 times 60, that is 1980 pounds. Suppose a middled-sized man has a surface of about 14 feet square, he will sustain 14 times 1980 pounds of water, that is 27,720 pounds. If a man sustains so much, who is but 14 feet square, how much weight of atmosphere will not the whole earth sustain, which hath a surface of more than two millions of square miles? Thus, whether the earth sustains a weight of water thirty-three feet high, or an airy atmosphere equal in weight, the difference is nothing, it will be equally pressed by both. Thus, in the atmosphere in which we move with so much freedom, and which we traverse with so much rapidity, we are pressed on all sides with an almost incredible weight, and our bodies seldom support less than twelve ton of air at a time.

So great a pressure of air upon his body may well surprise the ignorant, and shake his belief; but he must consider, that this weight of air he has carried from his earliest infancy. Sensations to which we have been always accustomed, are scarcely felt: we cannot perceive the difference of things, when we have no standard by which to measure their variations; we cannot perceive the weight of the air, because we have always felt its weight, and cannot remove from its pressure. No one part of the body can be disturbed by its pressure, for it lays the load equally upon all. Besides this, there is a resistance within the body, which serves to counterbalance that from without; and there is another consideration also, which naturalists have passed over unnoticed. The heat of our bodies rarifies the air on their surface; so that in fact an animal doth not sustain so great a pressure from the air as cold inanimate substances are found to sustain. In short, to use the words of Borelli, since by the air's pressure none of the parts of our bodies can suffer either separation, or luxation, or contusion, nor any other change, it is impossible that this pressure can produce any pain.

This pressure then can do no injury to the animal frame, we find it by experience of infinite utility. By it the parts of our bodies are kept compactly together, by it the fluids in our vessels are prevented from bursting their canals. Travellers, in ascending high mountains, feel the want of this pressure, to which they were accustomed in the valley: as they ascend, they perceive a total lassitude upon them from the dilatation of their vessels, and at last the blood begins to burst through the fine coats of the lungs, and they spit blood. It is probable that similar effects are not unfrequently produced by this variation in the weight of the atmosphere. Mead relates that Dr. Pitcairn, in the year 1787, being at his country seat near Edinburgh, in February, on a fairer day than usual at that season, was seized with a sudden bleeding of the nose after an uncommon faintness, and on the next day, on his return to town, he found that the *barometer* was *lower* at that very hour than either he or his friend Dr. Gregory, who kept a journal of the weather, had ever observed it: and that another friend of his, Mr. Cockburn, professor of philosophy, had died suddenly at the same hour by an eruption of blood from the lungs; and also five or six others of his patients were seized with different hæmorrhages.

SECTION VIII.

AIR SUPPORTS LIFE.

To shew "*that air is absolutely necessary for the preservation of life*," many have been the animals that idle curiosity has tortured in the prison of a receiver. We shall, from a thousand instances, produce that of the *viper*, as it is known to be a reptile exceedingly tenacious of life, and as we shall feel but little compassion for its sufferings.

Mr. Boyle took a new caught viper, and shutting it up in a small receiver of an air-pump, he exhausted the air. At first the reptile began to swell, it then moved up and down as if in quest of air, and after a while foamed, leaving the foam sticking to the sides of the glass. It continued in this state 23 hours, and appeared by its posture, even after the lapse of two hours, *lifeless.* But upon the air being admitted, the viper opened and closed its mouth, and continuing these alternate motions for a few seconds, it still argued some remains of life. Other creatures, in the exhausted receiver, much sooner grow convulsed and die.

SECTION IX.

THE AIR MUST BE RENEWED.

As *air* was shewn to be *absolutely necessary for the continuance of life*, "*so is a due supply of it indispensable.*"

The soubah, or viceroy of Bengal, dying in the month of April, in the year 1756, he was succeeded by his adopted son Sur Raja al Dowlah, a young man of the most violent passions, without faith, principle, or fortitude.

In the month of *May*, he caused the English factory at *Cassimbuzar* to be invested, and invited Mr. Watts, the chief of the factory, to a conference; he detained him as a prisoner, and made himself master of the factory.

He then marched to *Calcutta*, and invested this settlement, which was in no posture of defence. The *governor*, intimidated by the numbers and power of the enemy, abandoned the fort, and together with some of the principal persons residing in the place, took refuge on board a ship in the river, carrying with them their most valuable effects.

The defence of the place then devolved to Mr. Holwell, the second in command; who, with the assistance of a few gallant officers, and a very small garrison, maintained the place with singular courage and resolution, till at length, the enemy having forced their way into the castle, he was obliged to surrender; the soubah having first promised him, on the honour of a soldier, " that no injury should be offered him or his garrison."

Having made them prisoners, he ordered them, to the number of 146 persons, to be put into a place called the *Black-hole* prison, a cube of about 18 feet, open only to the westward by *two windows* strongly barred with iron.

The humane reader will conceive, with horror, the miserable situation to which they must have been reduced, thus stewed up, in a *close sultry night*, under the climate of Bengal, especially when he reflects that many were *grievously wounded*, and all of them *greatly fatigued* by the exertions of the preceding day.

A *profuse sweat* quickly broke out on every individual, attended with an *insatiable thirst*, which became the more intolerable as the body was drained of its moisture. It was in vain that they stript off their clothes, or fanned themselves with their hats.

A *difficulty in breathing* was next observed, and every one *panted for breath.*

Mr. Holwell, who was placed at one of the windows, accosted the serjeant of the guard, and endeavoured to excite his compassion, he drew a pathetic picture of their sufferings, and promised to gratify him in the morning with a thousand rupees, provided he could find means to remove some of his people into another place of confinement.

The Indian, allured by the promise of so mighty a reward, assured him he would use his utmost endeavour, and retired for that purpose.

What must have been the impatience at this time of these unhappy objects? — — — — —
— — — — — — — — —
— — — — — — — — —
— — — — — — — — —

In a few minutes the jemmaudar returned, *but the tyrant*, by whose order alone such a step could be taken, *was asleep, and no one durst disturb his repose!*

The despair of the prisoners now became outrageous. They endeavoured to force open the door, that they might rush on the swords of the monsters, by whom they were surrounded, and who derided their sufferings; but all their efforts proved ineffectual. They then used execrations and abuse to provoke the guard to fire upon them.

The jemmaudar was at length moved to compassion. He ordered his soldiers to bring some skins containing *water*, which, by enraging the appetite, only served to increase the general agitation. There was no other way of conveying it through the two windows but by hats, and this mode of conveyance proved ineffectual, from the eagerness and transports of the wretched prisoners who struggled for it in fits of delirium.

The cry of *Water! Water!* issued from every mouth.

The consequence of this eagerness was, that very little fell to the lot even of those who stood nearest the window; and even these, who were esteemed the most fortunate, instead of finding their thirsts assuaged, grew more impatient.

The confusion soon became general and horrid; all was clamour and contest; those who were at a distance endeavoured to force their passage to the window, and the weak were pressed down to the ground never to rise again.

Mr. Holwell observing now his dearest friends in the agonies of death, or dead, and inhumanly trampled on by the living, finding himself wedged up so close as to be deprived of all motion, he begged, as the last mark of their regard, that they would for one moment remove the pressure, and allow him to retire from the window, and die in quiet.

Even in such dreadful circumstances, which might be supposed to have levelled all distinctions, the poor delirious wretches manifested a respect for his rank and character: they forthwith gave way, and he forced his passage into the centre of the place, which was less crowded, because, *by this time*, about one third of the number had perished, while the rest still pressed to both the windows.

He retired to a platform at the further end of the room, and lying down upon some of his dead friends, recommended his soul to heaven.

Here his *thirst* grew insupportable; his *difficulty in breathing* increased; and he was seized with a *strong palpitation of the heart.*

These violent symptoms, which he could not bear, urged him to make another effort; he forced his way back to the window, and cried aloud, " *Water, for God's sake!*"

He had been supposed already dead by his wretched companions, but finding him still alive, they exhibited another extraordinary proof of regard to his person: " *Give him water,*" they cried; nor would one of them attempt to touch it until *he* had drank! He now breathed more freely, and the palpitation ceased: but finding himself still more thirsty after drinking, he abstained from water, and moistened his mouth from time to time, by sucking the *perspiration* * from his shirt sleeves, which tasted soft, pleasant, and refreshing.

The miserable prisoners now began to perceive it was *air* and not *water* that they wanted. They dropt fast on all sides, and a *pungent steam* arose from the bodies of the living and the dead, as *pungent* and *volatile* as *hartshorn* †.

Mr. Holwell being weary of life, retired once more to the platform, and stretched himself by the Reverend Mr. Bellamy, who, together with his son, a young lieutenant, lay dead, locked in each other's arms.

In this situation he was soon deprived of sense, and seemed to all appearance dead, when he was removed by his surviving friends to one of the windows, where the *fresh air* brought him back to life.

The soubah being at last informed that the greater part of the prisoners were *suffocated*, inquired if the chief was alive; and being answered in the affirmative, sent an order for their immediate release, when *no more than* 23 *survived of* 146 who entered into this prison alive*.

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* Does the aqueous perspirable fluid contain *oxygen* in a looser bond of union than water?

† Did not the superabundant *azot* unite with the *hydrogen* of the body, and form *volatile alkali?*

Another melancholy proof of the *necessity of a due supply of air*, may be drawn from the testimony of Dr. Trotter, delivered before a select committee of the *House of commons*, in the year 1790.

In July 1783, the slave-ship, in which he was, arrived at Cape *La How*, on the Gold Coast of *Africa*. In the space of a week above *one hundred* prime slaves, *young*, *stout*, and *healthy*, were purchased. The competition, however, of the purchasers at *Annamaboe*, whither this ship afterwards sailed, ran so high, that the captain could not obtain more than two thirds of the usual complement. The slaves were confined below sixteen hours out of twenty-four, and permitted no exercise when upon deck. The rooms, where they were secured, are from five to six feet in height. These rooms are imperfectly aired by gratings above, and small scuttles in the side of the ship, which of course can be of little use at sea. The gratings are also half covered, when it blows hard, to keep out the salt spray. The temperature of these rooms was often above 96 of Farenheit's scale. In the evidence, of which this is an abstract, Dr. Trotter affirms, he could never breathe there, unless under the hatchways. In such circumstances the sufferings of these poor creatures must have been dreadful. *I have often*, says Dr. Trotter, *observed the slaves drawing their breath with all the laborious and anxious efforts for life, which are observed in expiring animals, subjected by experiment to foul air, or in the exhausted receiver of an air-pump. I have often seen them, when the tarpawlings have been inadvertently thrown over the gratings, attempting to heave them up, crying out in their own language, " We are suffocated." Many have I seen dead, who the night before have shewn no signs of the smallest indisposition* ; *some also in a dying state, and if not brought up quickly upon the deck, irrecoverably lost.*

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* Mr. Holwell, and his surviving companions, were immediately after seized with a *putrid fever*, and in this condition dragged before the soubah to be questioned about a treasure, which he believed they had secreted. This gentleman, having denied the empty assertion, was, with three of his friends, loaded with fetters, and conveyed near three miles to the Indian camp, where they lay a whole night exposed to a severe rain. The next morning they were brought back to the town, chained and suffering the scorching rays of a sun intensely hot. Then large and painful petechiæ came out, and covered their whole body. In this piteous condition they were embarked in an open boat for the capital of Bengal, and underwent such cruel treatment and misery in their passage, as would shock the humane reader should he peruse the particulars. At length the soubah's mother interposed, and he replied, with an unexpected generosity, "*their sufferings have been great, and they shall have their liberty.*"

This fact throws a great light upon the origin of *putrid fever.*—The great and good Dr. Hales, whose studies and experiments were constantly directed to the benefit of mankind, recommended a trial of *ventilators* in the *Savoy* and *Newgate* prisons, in both of which the *jail fever* was frequent, and commonly fatal; the good effects exceeded even his most sanguine expectations; for a very small portion of the sick died, when the ventilators came into use, and the contagion seemed in a manner arrested. The benevolent Mr. Howard found the prisons on the continent perfectly free from *this pestilential fever:* owing, as he thinks, to the apartments in which the prisoners were confined being spacious, and consequently well aired.

Hence, before the arrival of this vessel at *Antigua*, out of 650 slaves more than 50 had *died*, and about 300 were tainted with the *sea scurvy* *.

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* This fact throws a great light on the *origin* and *nature* of *sea scurvy*, as will be shewn hereafter when treating on that disease.—In our unfortunate expedition to *Quiberon* there were an hundred picked horses put on board a tender. A storm coming on, the hatchways were closed, and these animals remained in this dreadful state above eight-and-forty hours. Ten were found suffocated, and sixty *glandered*, and communicated the disease to other horses when they landed. So sudden and general an infection, Mr. Coleman, the Veterinary Professor, thinks could not have

Mr. Wilson states, that in his ship, and three others belonging to the same concern, they purchased among them 2064 slaves, and *lost* 586. He adds, that he has known some ships in the slave trade bury a *quarter*, some *a third*, and others even *half* of their cargo.

To mention no other fact, a strong proof of *the necessity of a frequent renewal of the air,* may be found in the Records of the *Dublin Lying-in-Hospital.*

In this hospital 2944 infants out of 7650 died in the years 1782, 1783, 1784, and 1785, within the first fortnight after their birth, that is, nearly *one child* out of every *six.* They almost all died in convulsions, or what the nurses called *nine days fits*, because they came on within nine days after their birth. These children, many of them, foamed at their mouths, their thumbs were drawn into the palms of their hands, the jaws were locked, the face was swelled and looked *blue*, as *though they were choaked.*

This last circumstance led Dr. Clarke to conclude, that the rooms in the hospital were too *close* and *crowded*, and hence the infants had not a sufficient supply of *good air* to breathe. This benevolent physician contrived, therefore, *air-pipes*, 6 inches wide, which were placed in the ceiling of each room. Three holes, an inch wide, were bored through each window frame; and a number of holes were made in the doors at the bottom.

By these contrivances the rooms were kept *sweet* and *fresh*; and the *consequence* has been, from the register in that hospital, that,

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happened from the supposition that a glandered horse, by some oversight, had been shipt along with the rest, as it requires a week before this disorder could have infected others (as in the small-pox, &c.), and attributes the origin of *glanders*, in this instance, solely from the stived situation in which these poor animals were placed.

Children.

In 1786, out of	1372	there died	51
1787, ——	1375	——	59
1788, ——	1496	——	55
	4243		165

Now if out of 4243 children there perish, *when the hospital was ventilated*, only 165 infants, how many may be expected to die out of 7650, the number of children born in the *Dublin Lying-in-Hospital*, in the years 1782, 1783, 1784, and 1785 ?

The answer is, by the rule of proportion,—279. But how dreadful the account, there *died* absolutely 2944, that is 2665 solely *from the want of a due supply of air !*—and we have not only to deplore the number of innocent victims, who were destroyed in these few years and previous to them, but also to lament the wretched anguish of the disconsolate parents, and the impoverished state of health in many of the poor babes who survived this great slaughter.

SECTION X.

WHY THE AIR MUST BE RENEWED.

Having proved the connexion betwixt *life* and *air*, it is necessary now to shew *what are the chemical alterations air undergoes by being respired.*

Dr. Priestley having formed *nitrous air* by the solution of various metallic bodies in *nitrous acid*, he discovered that it possesses this singular property, that when mixed with *common air*, a great *diminution* of the bulk of the two *aerial fluids* takes place, attended with a turbid red, or deep orange colour, and a considerable heat.

I hardly know, says this philosopher, any experiment, that is more adapted to amaze than this, which exhibits a quantity of *air*, which, as it were, devours a quantity of *another kind of air*, half as large as itself, and yet, instead of acquiring *larger dimensions*, becomes itself *considerably contracted.*

We are not much surprised when we find an *aeriform body* starting out from a *solid substance*, as in the formation of *nitrous* and *other factitious airs*; but we are more sensibly affected, when, on the reverse, *two invisible aerial bodies* are converted into a *compact coloured fluid*; for, like condensed steam, they occupy, in *comparison* with their former dimensions, scarcely any perceptible *space.* Here the *nitrous air* attracts to itself *oxygen*, the base of vital air, *caloric* is given out, and *this combination* gives us *nitrous acid.*

This discovery * was a most agreeable one to me, adds this great experimentalist, as I hope it may be an *useful one* to the public. It is remarkable that *this air* occasions no effervescence or *diminution* with *fixed* or *inflammable airs*, but only with *air fit for respiration and combustion*, and, as far as I can judge, *exactly in proportion* to *its fit-*

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* This fact was known to Mayow, but practically employed as a test of goodness of air *first* by Dr. Priestley. There have been since several substances proposed for ascertaining with facility the quantity of oxygen in air; they have been called eudiometrical substances; and the instruments in which they have been employed, are named eudiometers. The solution obtained by water from sulphur and pearl ashes, or sulphur and lime that have been fused together, slowly absorbs oxygen; a solution of tin in muriatic acid has a similar property; and likewise solutions of iron, into which nitrous gas has been passed till they become coloured. A tube of glass graduated to 100 parts, forms a good eudiometer; and when filled with air, it is plunged into any solution that will absorb oxygen, and suffered to remain there, till the process be complete.

*ness for that purpose**; so that by this means the *goodness* of any air may be distinguished much more accurately, than by putting into it a mouse, or any other animal, to try how long it can exist in any given quantity. By *this test* I was enabled to perceive a *real difference* in the air of my *study*, after a few persons had been with me in it, and the air on the *outside of my house*. A phial of air being sent me from the neighbourhood of *York*, it appeared to be not *so good* as the air near *Leeds*; that is, it was not *diminished so much* by an *equal* mixture *of nitrous air*.

The justly celebrated chemist Lavoisier, ascertains the proportion of *vital air* † contained in any given quantity of *common air* by the means of *phosphorus*. His *eudiometer* is thus constructed. Having filled a cylindrical glass tube with quicksilver, he immerses it in a bason of the same fluid. He then puts into it *the air*, the purity of which he proposes to examine. He afterwards passes up the *phosphorus*, and having heated an iron wire at the extremity red hot, he applies the hot end to the *phosphorus* through the quicksilver, which quickly consumes ‡, and the quicksilver *rises* nearly 27 divisions (if the tube has been accurately divided into 100 parts *); after which time, if any *phosphorus* remains, it ceases to burn, there being no more *oxygen* in the tube to be attracted by the *phosphorus* †.

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* That is, in proportion to the quantity of *oxygen air* it contains, which will presently appear to be the *pabulum vitæ, or principle of life*. It was shewn before, that *atmospheric air* is a compound of *two distinct* and *solid substances, oxygen* and *azot*, rendered *aerial*, by the suspensive power of *caloric, fire.*

† The reader has already learnt, from the discoveries of Lavoisier, that *atmospheric air* consists of *two parts*, viz. *oxygen air*, blended with *azotic air*, which by chemical means may be separated, and confined in different jars, and that a mouse, or any other animal, will live a considerable time in the *one*, being lively, brisk, and active; whilst, in *the other*, he soon languishes and dies. *This part* of the air, therefore, as so much contributing to *life*, is with the utmost propriety denominated by physicians, VITAL AIR.

‡ *Phosphorus*, like other combustible bodies, attracts *oxygen*, the particles being once separated beyond their sphere of mutual attraction, or

By *this means* Lavoisier ascertained, that when the *air out of doors* consisted of

27 parts *oxygen air*,
and 73 —— *azotic air*,

100 parts.

The air in the lowest ward in the *General Hospital* at *Paris*, *contained*

but 25 parts of *oxygen air*,
and 71 —— of *azotic air*,
and 4 —— of *fixed air*,

100 parts.

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the attraction of cohesion. The *caloric*, which is disengaged from the *attracted oxygen*, answers the same purpose as the *hot iron* which first kindled the *phosphorus*. The *phosphorus* becomes in consequence of this union with *oxygen*, *phosphoric acid*.

* In 100 parts of atmospheric air, there is most commonly found 27 of *oxygen air*; or, in other words, in 100 *gallons* of *air*, there would be found 27 *gallons* of *oxygen air*, and 73 of *azotic air*.

† This clearly evinces that *combustion* is the divorcement of *oxygen* from *caloric*, *which being set at liberty*, assumes, as it is escaping the character of *flame* or *fire*, for the *phosphorus* no longer burns, than while *oxygen air* is present, and the *phosphoric acid* will have an *increase of weight* exactly corresponding to the *weight* of *oxygen air consumed*: that is, 100 parts of *phosphorus* will absorb 154 parts of *oxygen* or the base of *vital air*.

This proportion varied in different parts of the same room. At the *top* the air had suffered much more injury. It contained

but 18½ parts of *oxygen air*,
and 79 —— of *azotic air*,
and 2½ —— of *fixed air*,

100 parts.

And when, before the play, the *air* in the *theatre* in the Thulieries contained

27 parts of *oxygen air*,
and 73 —— of *azotic air*,

100 parts;

Towards the conclusion of the piece, which was acted before an unusual concourse of spectators, it contained

but 21 parts of *oxygen air*,
and 76½ —— of *azotic air*,
and 2½ —— of *fixed air*,

100 parts.

Whence it is evident, that the *quantity* of *oxygen*, or *vital*, *air* had been diminished in the theatre in the proportion of 27 to 21, or nearly *one fourth*; that is, it was *one fourth less fit for respiration than before.*

The air of the atmosphere, therefore, which is originally composed of 2 *fluids*, is composed of 3 *aerial fluids*, in all places which contain numerous assemblies of people. *These three aerial bodies*, though blended together, arrange themselves in some degree according to their specific gravities; that is, the proportion of *azotic air*, which is the lighter body of the three, will be found most in the *upper part,* the *oxygen air* in the middle, and the *fixed air* will be found most in the *lower part* of the apartment.

This occasions a circulation in the air, for, in spite of the architect, the *rarefied air* will ascend, the *fixed air* sink, and the *colder* and *purer air* rush into the apartment through every crevice *.

Unless *this were the case,* and unless *the air was constantly renewed,* the spectators would be exposed to the most fatal accidents long before the conclusion of the performance.

To convince ourselves of this truth, nothing more is necessary than to take the example of an assembly-room, let it be supposed 30 feet long by 25 and 30 feet high.

A room of these dimensions would contain 100 spectators. Now since each person consumes about 5 cubic feet of air in an hour, that is, deprives such a quantity of air of its oxygen air or *vital principle*, it would follow, that as such a room could contain only 22,500 cubic feet of air, that unless the air was constantly renewed it would be rendered completely mephitic or noxious in about *four hours and an half*, and it is probable that the greater part of the audience would be seriously incommoded, or even perish, long before the end of that period.

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* To render the *circulation* of the air *sensible;* if the air of a room be *heated* by fire in it, whilst the air in a contiguous room is *cold*; then let the door between these two rooms be opened, in which case the *hot air* of one room being *rarefied* will pass through the *upper part* of the opening of the door into the cold room; and, on the the contrary, the *cold air* of the other room being *heavier,* will pass into the former through the *lower parts* of the opening. This may be proved by applying a candle at the *top* and *lower parts* of the opening between the two rooms. The direction of the flame of the candle will point out the *contrary currents of air.* It is for this reason that when a fire is lighted in a chimney, a *strong current of air* enters the room, which may be felt by applying the hand near the key-hole, or other small openings, if the doors and windows be shut. It is in this way that a fire is said to purify a room; but this effect is only because the fire promotes the *circulation* of the air, and dries the dampness of the apartment: so that it is not the infected air that is purified, but a *new, fresh,* and *wholesome air,* by the action of fire, that is made to take place of a bad and corrupt air. Hence it appears, that those persons are mistaken who are over-anxious in keeping out the air from entering the apartments of convalescent persons, by *accurately stopping, by list, linings,* and *sand-bags, all the smallest openings that admit fresh air.*

The same calculation applies to all confined places, where a number of persons are assembled together: especially if the air circulates in them slowly, or with difficulty: *the oftener it is respired the more it will become vitiated*; and it is easy to observe how the attention of the audience fails them in crowded churches. They can no longer listen to the discourse. The irritating quality of the mephitic air excites a general coughing. The preacher now receives none of those marks of attention or respect, which in more favourable circumstances he had a right to expect. They experience a drowsy head-ache. They express even a physical anxiety to be gone, and the congregation feel themselves on returning home jaded, and till revived by a *more wholesome or oxygenated air* they look wan, like persons who are ready to faint away.

SECTION XI.

THE CHEMICAL ALTERATION AIR UNDERGOES BY BEING RESPIRED.

It will be seen from the last section, that if an animal be confined under a bell-glass, where all admission of fresh air be denied, the air which before consisted of 2 *aerial fluids*, viz.

1. *oxygen air*,
and 2. *azotic air*,

will presently consist of 3 *aerial fluids*;

1. *oxygen air, in a diminished quantity,*
2. *azotic air,*
and 3. *fixed air.*

At length the *oxygen air* being consumed, the animal will cease to live, and the air in the bell-glass will be found to consist now of 2 *aerial fluids* only, that cannot maintain life, viz.

1. *azotic air,*
and 2. *fixed air.*

A question naturally arises, *what has become of the oxygen, or vital, air,* deprived of which an animal *dies?*

OFFICE OF THE LUNGS.

In the lungs the blood coming into contact with *atmospheric* air* works many chemical alterations in it.

Here it is (in the cells of the lungs) that the dark blood, throwing off attenuated *carbon*, forms with the VITAL AIR of the atmosphere,—*fixed air* †:

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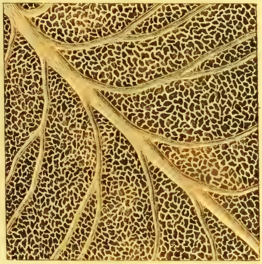
* " *Respiration* we cannot explain: we only know," says Dr. Hunter, in his Introductory Lecture which he published in the year 1784, " that " it is, *in fact,* essential and necessary to life. Notwithstanding this, " when we see all the other parts of the body, and their functions, so well " accounted for, we cannot doubt but that *respiration* is so likewise.— " And IF EVER we should be happy enough to find out clearly the ob- " jects of this function, we shall, doubtless, as clearly see, that *this organ* " is as wisely contrived for *an important office,* as we now see the purpose " and importance of the *heart*, and vascular system; which, till the cir- " culation of the blood was discovered, was wholly concealed from us."— If this learned teacher was to rise from the grave, I believe, no subject would give him higher delight than to behold, issuing from the furnaces of the chemist, a new and simple philosophy, which has clearly developed the *nature* and *necessity* of *respiration.*

† This is proved by making an expiration through a tube containing

THREE SMALL PORTIONS OF THE LUNGS.

The air-cells of the Lungs;
FIG. 1.



These cells magnified.
FIG. 2.

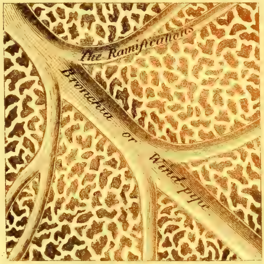


FIG. 3.

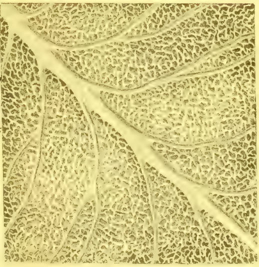


FIG. 1. 2. *Shew the air-cells of the Lungs at the moment of Inspiration; when the blood in the minute veſsels covering yᵉ air-cells, has Imbibed the* VITAL-AIR, *and thrown off* CARBON & HYDROGEN.

FIG. 3. *Shews the air-cells a few moments after Expiration, when a new & dark column of blood pervades the air-cells, replete with* CARBON & HYDROGEN, *and devoid of* VITAL AIR.

London, Pub. by Sherwood, Neely & Jones, 1819

Here it is, that the purple blood parts with its *hydrogen*, which, uniting with the VITAL AIR, forms — the *humid vapour* that issues from the mouth *.

And here it is, that the *dark blood* (having thrown off *hydrogen* and *carbon*) *imbibes* the VITAL AIR, which changes its *purple colour* to a *brilliant red.*

I. EXPERIMENTS TO PROVE THAT PURPLE VENAL BLOOD ABSORBS OXYGEN AIR.

If blood be taken from a *vein*, it readily separates into 2 parts, a thin semi-transparent fluid called *serum*, and the *crassamentum*, floating on it.

This firm substance at first appears of a *dark purple colour inclining to black*, but soon it assumes on *its upper surface a bright scarlet appearance*, resembling the blood contained within *an artery*.

To prove that *this florid colour* is owing entirely to the absorption of *oxygen air* (one of the principles of *common air*), Dr. Thornton enclosed a quantity of *vital air* in a glass receiver inverted over quicksilver, and introduced into it 4 ounces of blood fresh drawn from the *jugular vein* of a sheep: the blood became instantly *very florid*, and the quicksilver seemed to *ascend* a little in the receiver. To ascertain this latter circumstance, he repeated the same experiment three or four times ; *the change of colour* in

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lime-water, which will become instantly *turbid.*—Or if black blood be confined in a phial containing *vital air*, the whole of *that air* will be converted into *fixed air.*

* This you may prove by placing venal blood in *vital air*, when the sides of the vessel will be covered with large drops of *water.*—Or if black blood be received into a phial containing *azotic air*, *ammoniac* will be formed, which has been shewn by Bertholet to be nothing more than *hydrogen* combined with *azot.*

the blood was always *very sudden,* and after several minutes the quicksilver *ascended* two or three lines, and the blood encreased in weight.

If *oil* be spread on the surface of the blood, which will prevent the contact of air, no such alteration as to colour takes place.

Dr. Thornton, who turned his thoughts much to this subject, discovered that *venal blood* not only assumed a *bright vermilion colour* when exposed to *oxygen air,* but gave out *carbon* and *hydrogen,* which uniting with the *oxygen air,* formed *fixed air* * and *water* †, which was found on the surface of the quicksilver.

II. EXPERIMENTS TO PROVE THAT CRIMSON ARTERIAL BLOOD CONTAINS OXYGEN AIR.

The *arterial blood* from the carotid artery of a sheep was received into a bottle full of *azotic air.* The blood from a *bright red* shortly assumed the *deep colour of venal blood.* On opening the bottle the next day, Dr. Thornton found the *azotic air* which it before contained was mixed with *oxygen air,* so that an animal could live in it, and a candle burnt in it for near two minutes.

This experiment proves decisively that *arterial blood* contains *oxygen air,* and that as soon as it parts with *this air* it then reassumes the true *venal character.*

The *arterial blood* of the carotid artery of a sheep was received into a bottle full of *nitrous air.* The blood assumed a *green* colour * upon the surface. A small quantity of greenish serum was separated. The day after, on opening the bottle, the vapour of *nitrous acid* was observed by all who were present.

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* *Charcoal* and *oxygen air.*

The presence of *fixed air* is ascertained by *lime water;* for water dissolves *lime,* and holds it suspended. The solution then appears perfectly clear and bright. If any *fixed air* comes into contact with the water, the *carbonic acid* seizes on the *lime,* and makes with it a combination *insoluble* in *water.* The *lime,* in that case, is *visible* in the water. *Lime water* is therefore a test of the presence of *fixed* or *carbonic acid air.*

† *Hydrogen* and *oxygen.*

Here then is an experiment which also proves *the presence* of *oxygen air* in the *arterial blood*; since it is from this circumstance alone that it is capable of changing *nitrous air* into *nitrous acid* †.

III. DR. GOODWIN'S EXPERIMENT.

But that no possible doubt might exist, that *oxygen air* is imbibed *by the blood* in *the lungs,* Dr. Goodwin opened the chest of a living dog.

The LUNGS and HEART were then exposed to view.

The blood, which was driven from the *right ventricle* of the heart into the *pulmonary artery* ‡, appeared of a *dark venous complexion.*

It certainly was a striking spectacle to observe the *black blood,* as it returned from the lungs by the four *pulmonary veins* § of the *lungs,* in its passage to the *left auricle* of the heart, appear of a *bright vermilion colour.*

It was soon found necessary to inflate the lungs by artificial means.

If at any time this was intermitted, the blood in the four

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* Dr. Girtanner having injected some *nitrous air* into the *vein* of a dog, when it came into contact with the common air admitted into the lungs, *nitrous acid* was formed, and the lungs assumed in consequence a *greennish hue.* The blood returned by the veins to the heart was found *black.*

† Vide Sect. X. p. 99. An account of Dr. *Priestley*'s forming Nitrous Air.

‡ Vide Map of the Heart, figure (5).

§ Vide Map of the Heart, figures (8), (9), (10), (11).

pulmonary veins appeared of a *dark purple colour*, and the *left division* of the heart receiving *black blood*, a *diminution* of the pulsations of the *heart* and *arteries* took place, and in a little time all *their actions* ceased.

But if at this time the *lungs* were made by the *inflation* of common air alternately to collapse and distend, the blood in the *pulmonary vessels* regained its former *crimson colour*, and *the action* of the *heart* and *arteries* was *excited anew**.

Thus, if we open the breast of a frog, and stop the trachea, or windpipe, we observe, first, its pulmonic blood *florid*, and the heart beating strongly; secondly, some time after, the pulmonic blood has become of a *dark colour*, and the heart's motion has grown languid; after this, the pulmonic blood becomes *black*, and the pulsation of the heart ceases; and, lastly, the trachea of the frog being untied, and the creature allowed to breathe again, the blood becomes *crimson*, and the heart acts with its pristine vigour.

SECTION XII.

THE CIRCULATION OF THE BLOOD.

The immortal Harvey, the pride of our country, was the discoverer of the circulation of the blood. "Seeing,"

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* A similar experiment to this was performed by the illustrious Hook before the Royal Society an hundred years ago, when an animal, whose heart was exposed to view, was kept alive a whole hour by the inflation of its lungs. When this was omitted, the heart began to beat slower, and soon ceased all action, the eyes sunk, and the animal became convulsed; but all these symptoms disappeared as soon as the lungs became again inflated with air. An experiment of the same kind is also related by the illustrious John Hunter, which shewed most evidently the connection of respiration with the *colour* of the blood and action of the heart. Vide Hunter on Suspended Animation, in vol. ii. of our work.

WILLIAM HARVEY, M.D.

G. Johnson pinx.t J. Caldwall Sculp.t

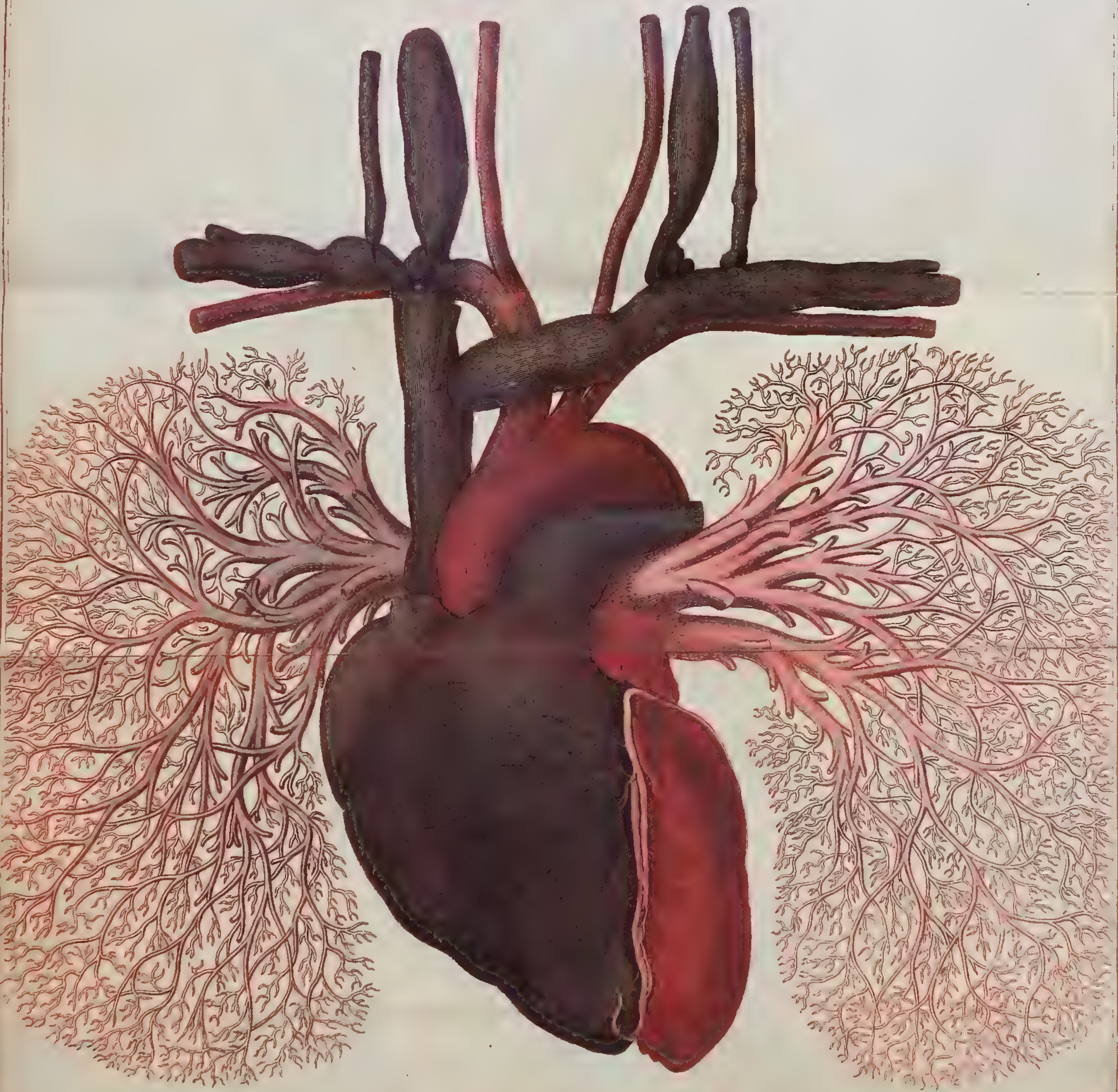
London, Pub. by Sherwood, Neely & Jones, 1813

says he, " that the blood passed from the arteries in abundance into the veins, unless these were to empty themselves, and the others to be refilled, that ruptures of vessels every where would take place, which does not happen, I began to conjecture, there must be a circular motion of the blood; but this doctrine was so *new* and *unheard of*, that I feared much detriment might arise from the *envy* of some, and that a number would take part against me, so much does custom and doctrine once received, and deeply rooted, pervert the judgment. However, my resolution was bent to set this doctrine forth, trusting in the candour of those who love and search after truth." In a letter to professor Riolan this great man complains, " Since the publication of the circulation of the blood, almost no day has passed in which I have not heard both good and evil of my doctrine. Some say ' that, this babe of mine is worthy to be fostered; and that I have by many observations, and ocular testimony, confirmed the circulation of the blood.' Others think ' that it is not as yet sufficiently illustrated, and free from objections;' and others again cry out, ' that I have affected a vain commendation of myself from dissecting of living animals, among which they deride my having made mention of frogs, mice, and other such contemptible creatures, and do not refrain from the most opprobrious language.' It cannot be helped," adds Harvey, " but that dogs will bark, and cynics pretend to mix with philosophers, but I shall take special care, that they do not bite, and destroy with their dogs teeth the very marrow of truth. They rail against me, because I do not answer the surfeits they have belched up. Detractors, mimics of men; let them know, that I never intend to read works that can have nothing of solid sense in them, much less should I esteem them worthy of an answer. It would be unworthy of me to return opprobrious language for theirs. I shall do better, for *I will overcome opposition by truth*; and if they will consider with me the anatomy of the vilest insect, they will find a God equally in the humbler, as in the higher works of creation."

Such, however, was the power of prejudice, that it is observed by Harvey "that no physician passed the age of forty believed in his doctrine," and it is a known and melancholy fact, that his practice declined from the moment he published this ever memorable discovery.

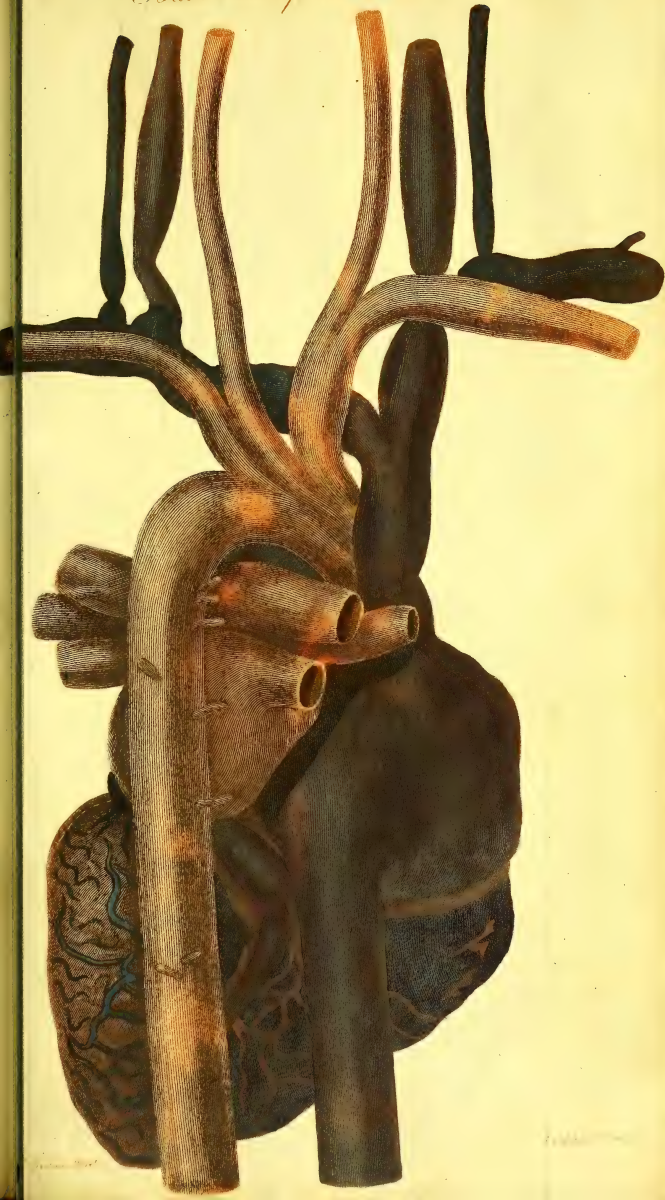
"*The new doctrine* at last getting into some vogue, the *senior* physicians," says Malpighi, "were inflamed to such a pitch at Bononia, that in order to root out heretical innovations in philosophy and physic, they endeavoured to get an act passed, whereby every graduate should be obliged to take the following *additional clause* to his solemn oath on receiving his degree; '*You shall likewise swear that you will, with all your might* (pro toto tui posse) *preserve and defend the doctrines of* Hippocrates, Aristotle, *and* Galen, *which are taught in this university, and have been approved of during a long series of ages; and that you will not permit their principles and conclusions to be overturned by any person whatsoever.*'

"It may be useful," writes the justly celebrated Dr. Hunter, "as well as entertaining, to remark, that *improvements* in medicine have always been among men an object of contention. A little reflection on human nature will shew that *vanity* is the principal source of *this absurdity*. All men wish to be respectable; and most of them to pass in the world, *for what they are not*; for being *so very acute, judicious*, and *learned*, as to need *no new instructions*. Hence *professors* assume a decided and dictatorial character, affecting to have gone to the *bottom of every thing*, and to have *overcome every difficulty*, either by the natural powers of their understandings, or by the severity of their studies,



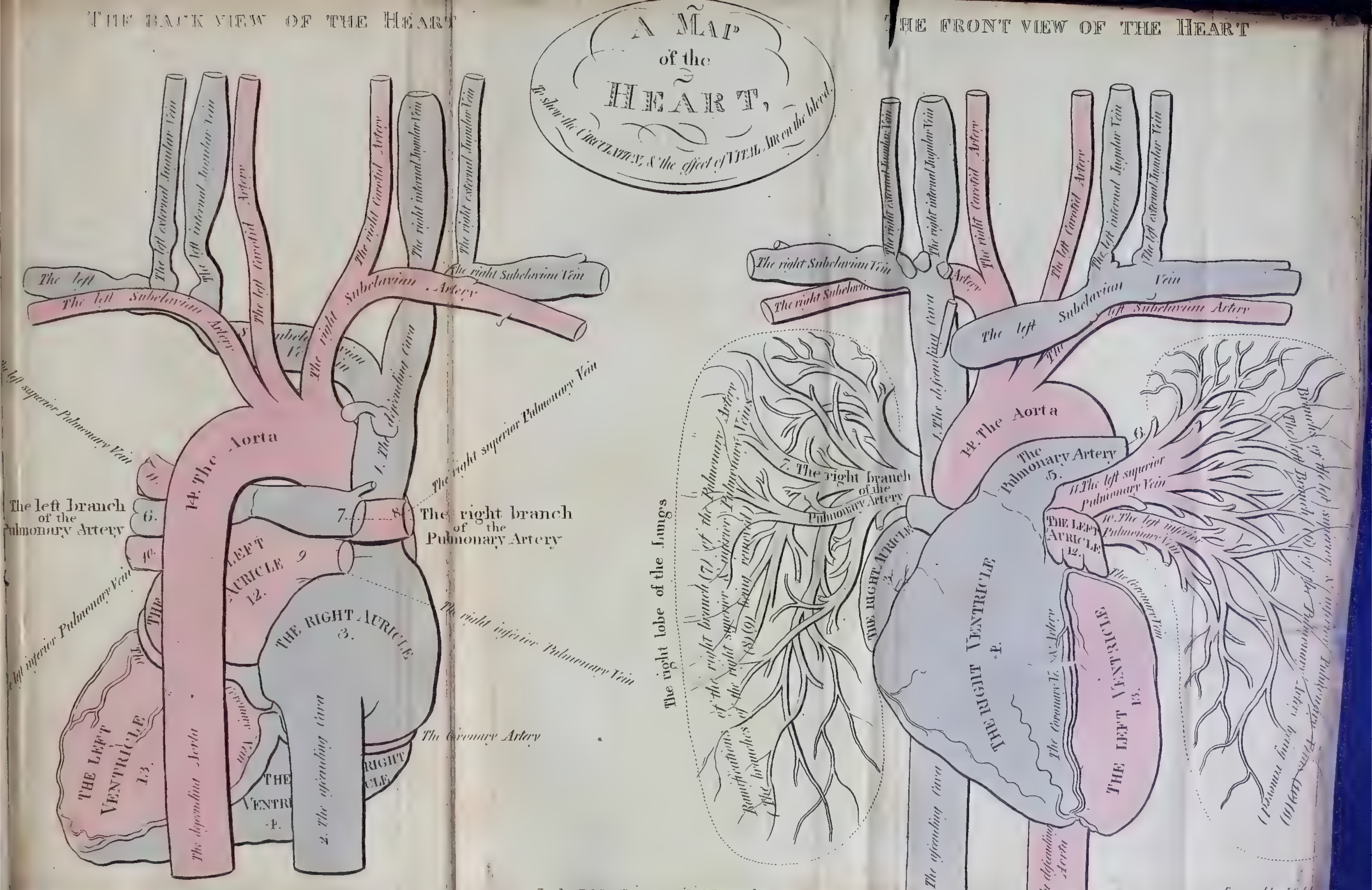
London, Pub. by Sherwood [illegible]

Back view of the Heart.



A MAP of the HEART,

To shew the CIRCULATION, & the effect of VITAL AIR on the blood.


THE BACK VIEW OF THE HEART
The left external Jugular Vein
The left internal Jugular Vein
The left Carotid Artery
The right Carotid Artery
The right internal Jugular Vein
The right external Jugular Vein
The left Subclavian Vein
The left Subclavian Artery
The right Subclavian Artery
The right Subclavian Vein
The right Subclavian Vein 17
1. The descending Cava
The left superior Pulmonary Vein
11
The left branch of the Pulmonary Artery
6.
10.
The left inferior Pulmonary Vein
14. The Aorta
7.
8
The right branch of the Pulmonary Artery
The right superior Pulmonary Vein
THE LEFT AURICLE 12.
9
THE RIGHT AURICLE 3.
The right inferior Pulmonary Vein
The Coronary Artery
THE LEFT VENTRICLE 13.
The descending Aorta
Coronary Vein
THE RIGHT VENTRICLE 4.
2. The ascending Cava
THE FRONT VIEW OF THE HEART
The right external Jugular Vein
The right internal Jugular Vein
The right Carotid Artery
The left Carotid Artery
The left internal Jugular Vein
The left external Jugular Vein
The right Subclavian Vein
The right Subclavian Artery
Artery
1. The descending Cava
The left Subclavian Vein
The left Subclavian Artery
14. The Aorta
6.
The Pulmonary Artery 5.
7. The right branch of the Pulmonary Artery
The right lobe of the Lungs
Ramifications of the right branch (7) of the Pulmonary Artery
The branches of the right superior & inferior Pulmonary Veins (8) (9) being removed
THE RIGHT AURICLE 3.
11. The left superior Pulmonary Vein
10. The left inferior Pulmonary Vein
THE LEFT AURICLE 12.
Branches of the left Branch (6) of the Pulmonary Artery
The left superior & inferior Pulmonary Veins (10) (11) being removed
THE RIGHT VENTRICLE 4.
The Coronary Vein
The Coronary Artery
THE LEFT VENTRICLE 13.
2. The ascending Cava
The descending Aorta

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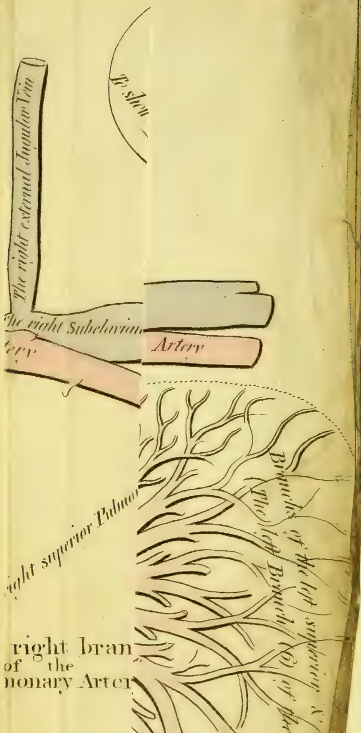
Engraved by J.Cald


To shew
The right external Jugular Vein
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Branches of the left superior & inferior Pulmonary Veins (10)(11)
The left Branch (6) of the Pulmonary Artery being removed)

Engraved by J.Cald

London,

and perseverance in the pursuit of knowledge. *Old men*, besides, can seldom bear, what they think an inversion of the natural order of things, that younger persons should instruct them. Of all men, *teachers* of every kind bear this with most impatience. For that reason we see, in fact, that the *seniors of schools, colleges*, and *public foundations*, have generally been the most obstinate *in shutting out light*, and claiming a *birth-right* for *opinions*, as for *property*. It is easy to see that *such men* will resist *new doctrines* with more obstinacy than the rest of mankind, perhaps with *inveteracy*, in proportion as the doctrines *are well founded* and *readily credited*. They will be sensible that many persons who embrace the *new opinion*, will call to mind *many looks of importance*, and *expressions of vanity*, which must *now* appear truly contemptible." Dr. Harvey, a few years before his death, had the happiness, however, to find the clamours of ignorance, envy, and prejudice, silenced; and *professional men* grew at last ashamed to own, that they had *ever* combated or disbelieved the *circulation of the blood*.

The doctrine taught by Harvey is,

That all the veins of the body falling into *two trunks*, viz. the *ascending* (1), and *descending*, *cavæ* (2), empty themselves into *the right auricle* of the heart (3). *The right auricle* unloads into *the right ventricle* of the heart (4), *which* throws the blood through *the pulmonary artery* (5) into *the lungs*, by its *two branches* (6) (7), which go to the *right* and *left lobes*.

From *the lungs* the blood is brought back by *the four pulmonary veins* (8), (9), (10), (11), into *the left auricle* (12), and from thence it passes into *the left ventricle* (13), by *which* it is distributed through *the body* by means of the *aorta* (14), and its branches. *These* terminate in *the veins* of the body, which collect the blood and bring it back to the heart by the *two cavæ* (1) (2). Or, in other words,

That the *heart* is divided into 2 *parts* by a *longitudinal fleshy* separation. *These* 2 *parts* are formed into 2 *cavities* by a *laternal membranous valvular* separation.

The *veins** enter the 2 *upper cavities*, or *auricles*, and the *arteries* † go out from the 2 *lower cavities* or *ventricles.*

When the *auricles* contract, the blood is driven into the *ventricles*; and when *these* contract, it is forced into the *arteries.*

Then *commences*, in fact, *the double circulation of the blood.*—The *arteries* † contract, and the blood flows from the *right division* of *the heart through the lungs*, to enter the *left division* of *the heart* :—and from the *left division* of *the heart*, the blood passes *through the various parts of the body* to enter again the *right division of the heart.*

Such indeed are the *admirable organs* destined for *the circulation of the blood.* But how greatly does this imperfect sketch fall short of the reality! How incapable are these outlines of expressing the beauties of this noble subject!

In a whale the aorta is of the size of the arch in London bridge, and the blood flows through it with equal impetuosity. It is calculated that the whole mass of blood pervades every part and returns to the heart, every half hour day and night!

There is in the consideration of *the organs* performing the circulation of the blood, an air of *grandeur* that seizes forcibly on the mind, and penetrates it with the highest admiration ‡.

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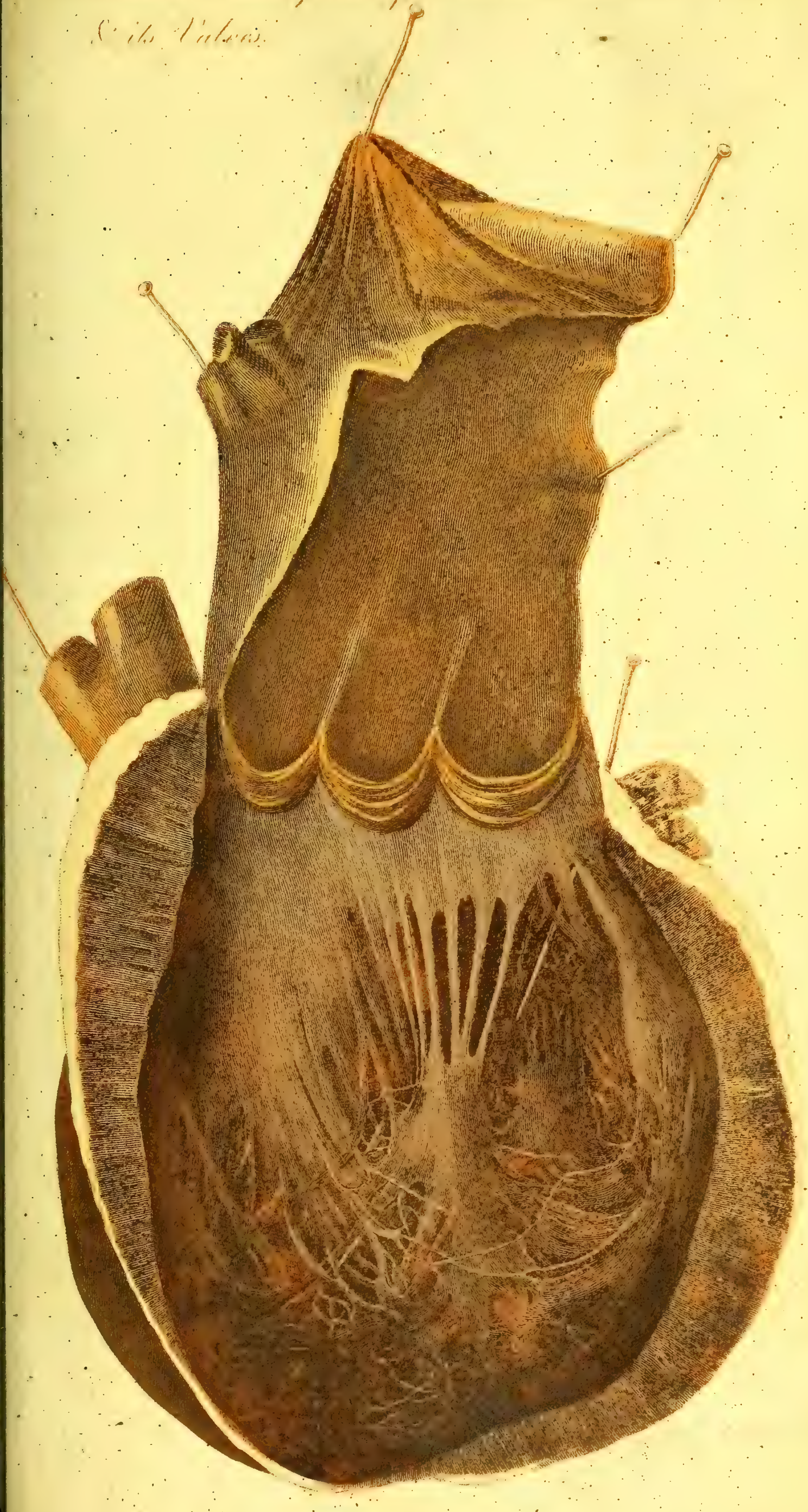
* Viz. the *two venæ cavæ*, and the *four pulmonary veins.*

† Viz. the *aorta*, and the *pulmonary artery.* Vide Map of the Heart.

‡ When the coloured plates of the heart of the natural size (these represent the front and back view of the heart with the pulmonary vessels)

Interior view of the Left Ventricle with the Aort & its Valves.



London, Pub. by Sherwood, Neely & Jones, 1813.

Far *less magnificent* in their plans, *less skilful* in the execution of them, *hydraulics* offer us but *faint images* of this miracle, in those machines, by means of which water is distributed into every quarter of a great city.

The works of the CREATOR must be compared to the *emanations* of the same *infinite mind.* Ever like himself, *he* has impressed on all *his* productions a character of nobleness and excellence, which demonstrate their *divine original!*

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were shewn to that great architect Sir William Chambers, and the circulation there explained was read by him, he held up his hands with astonishment and admiration. These two superb plates, with explanations, are published, and sold by Sherwood and Co. at ten shillings and sixpence.— Mr. Cruikshank, in his public lectures, always exhibits them to his pupils, recommending them in the strongest terms. They are the commencement of a series of anatomical plates of the size and colour of life, or parts injected, and, as being more permanent and cleanly than the real subject, will meet, we trust, with the countenance of the public at large.

Numbers III and IV, exhibiting the interior structure of the heart, are now in the hands of the Engraver, and will be speedily published; also Numbers V and VI, shewing the nerves of the heart, and Number VII, shewing the heart and lungs in their natural situation, when they first present themselves to our view. This most useful and magnificent work will be comprised in about twenty numbers, exclusive of the muscles and ligaments. The bones are not comprehended, being best learnt by the skeleton.

Such was the note in the early editions of the Philosophy of Medicine; but these *anatomical plates*, meeting with no suitable encouragement, were not continued; but, on the same scale and plan, picturesque Botanical Coloured Plates to a *New Illustration of the Sexual System*, were adopted and completed, which the great Doctor Darwin, in his Phytologia, says, "have *no equal*;" yet Doctor Thornton still hopes, that he may be enabled to resume this early project, and for which the names of subscribers will be received by Cox, St. Thomas's-street, Borough; UNDERWOOD, Smithfield; and CALLOW, Crown-court. Names only received.— The price of each Number is ten shillings.

SECTION XIII.

ON THE PULSATION OF THE HEART AND ARTERIES AS DEPENDANT UPON VITAL AIR.

"Hinc quoque apparet sanguinis *principalitas,* quod *pulsus ex eo ortum ducat.* Nec sanguis solum pars primigenia et principalis dicendus est, quod ab eo motus pulsusque principium orietur; sed etiam quia in eo primum *calor animalis* innascitur, *spiritus vitalis* ingeneratur, et *anima ipsa* consistit." HARV. Exer. 51.

"Hence also appears the *pre-eminence* of the blood, that the *pulsation* of the *heart* and *arteries* owes *its origin* to it. Nor is the blood to be called the *first mover* and *pre-eminent* for this alone, but because from it springs the *vital heat,* the *animal spirits,* and *life itself.*" Harvey's 51st chapter.

How infinitely near does the immortal Harvey approach the truth, and yet, I believe, he had not the most *distant conception,* that OXYGEN AIR was the *principle* from whose *benign influence* all *these wonderful phenomena* arise.

It is the knowledge of air, and aerial fluids, that has brought to light all the beautiful discoveries which modern physiology can boast of.

In the last section it was shewn, how the blood was a fluid of a rich *vermillion colour* in the *arteries*, and of a strong *purple colour* in the *veins.* When Dr. Goodwin opened the thorax of a living dog, the lungs being collapsed, the heart soon ceased to play, the animal then languished, and seemed expiring, but was revived again when *air* was blown into his lungs: then began again the motion of the heart; the blood receiving the stimulating influence of *vital air*, acted on the left side of the heart, and the right side moved in sympathy *, and the circulation was excited anew, and life continued. Now, this change in the motion of the heart happening so plainly from access of *air*, is a circumstance of the most interesting nature, and obliges us to look into the doctrines of chemistry for the solution of a phænomenon to which there is in the whole animal œconomy nothing to be compared.

On this occasion it is obvious to remark the *importance of the* LUNGS. We perceive that the blood, every time it is *returned* to the *right ventricle* of the *heart*, is directly dispersed through *the lungs*, and *immediately reconveyed to the heart, before it is permitted to begin a new circulation*; I may add before it is *capable* of performing *a new circulation:* for had there been no real necessity, we may boldly assert, this operation of the blood *passing from the right side of the heart through the lungs to the left* would never have taken place. In the study of Nature, throughout all her works, however *complex* the machine, the *utility* of each part ever claims the admiration of the speculative mind. This observation is beautifully illustrated on the present occasion; and I believe it will be admitted by every one, that the blood, after having performed *one round* throughout the animal œconomy, undergoes some *new* and *important change*, in its *transit through the lungs*, essentially requisite to support a *second circulation.* This change is certainly the *oxygenation* of the blood, and we should expect, if *oxygen* be the natural stimulus * to the heart and arteries, that their pulsation would be in proportion as the blood had access to this principle. That this is really the case, appears from the following experiment, made before a most respectable society of gentlemen, who met once a week at Dr. Higgins's, for the purpose of making philosophical experiments.

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* It may be objected, that the right side of the heart pulsates, although it receives only *venal blood*. To solve this difficulty we are obliged to use the word *sympathy;* thus if the nostrils be irritated, the muscles of the diaphragm are thrown into spasmodic action, and an irritation of the stomach brings into action all the abdominal muscles. Thus a disease of the kidney is marked by a numbness along the thigh, a gall stone by vomiting, and a disease of the liver by pain on the scapula. Of the cause of this connexion we are ignorant, and therefore are reluctantly obliged to have recourse to the term *sympathy*.

" Although Mr. Taylor was not more than 22 years of age, his natural pulse was only 64 previous to the experiment we are about to relate. During the inhalation of 19 pints of *oxygen air*, his pulse, as Dr. Higgins remarked, was quickened to 90 *beats in a minute*, and was considerably increased in *fulness* and *strength*. The vessel being immediately charged again with 19 pints of pure *oxygen gas*, he respired these also, and consumed them entirely in six minutes. His pulse was in consequence increased to 120 *beats in a minute*, and was *vigorous withal* †."

Similar have been the observation upon persons in states of disease breathing a *superoxygenated air* ‡.

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* As a negative proof, we have those experiments where persons have breathed a reduced atmosphere. " One consumptive patient, contrary to my judgment," says Dr. Beddoes," used to inhale at times air wholly deprived of *oxygen*. During this process I have felt the pulse nearly '*obliterated*.' He loved to indulge in it, and describes the incipient insensibility produced on him as a state highly delightful." Vide Dr. Beddoes's *Observations*, p. 30.

† See *Minutes of the Society for Philosophical Experiments*, by Dr. Higgins, p. 146.

‡ Vide the collection of cases, where the gases were applied, at the end of this work.

SECTION XIV.

ON THE VITALITY OF THE BLOOD.

The intimate connection, which subsists betwixt the life of man, and the air he breathes, was entertained in the remotest ages. Some even suppose that, speaking of the creation, when Moses says, "God breathed into "man *the breath of life*," he alludes to this intimate union, and that " in the image of God created he man," relates more particularly to the union of *soul* and *body*.

Hence the injunction to the Jews in *Leviticus* against eating blood, " for the *blood* of the animal is the *life* thereof." Thus Virgil says in the *Æneid*,

> *Vitam cum sanguine fudit.*

And again,

> *Unâ eâdemque viâ sanguisque animusque sequunter.*

And speaking of the death of Rhœtus, the poet again says,

> *Purpuream vomit ille animam.*

It would be tedious to quote all the suggestions of this sort entertained by the ancient physicians *.

The immortal Harvey must be considered as the chief among the moderns who introduced the apparently strange doctrine of the *vitality* of the blood. He concludes his fifty-second dissertation with these memorable words: " Inde concludimus sanguinem per se vivere." " Hence

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* Have the ancients named the *arteries* from αερ, *the air*, supposing, I suspect, these to carry the air to the living body along with the blood, which modern physiology has particularly confirmed?

"we conclude that the blood lives." This opinion of the *vitality of the blood* was however neglected, until it was revived by JOHN HUNTER *, who taught in his lectures, that the *fluids* as well as the solids were possessed of the *principle of life.* "That the blood has *life,* is an opinion," say he, "that I have started above thirty years, and have taught it for near twenty years in my lectures; it does not therefore come out at present † as a *new* doctrine, but has had time to meet with considerable opposition, and also to acquire its advocates. To conceive, that the blood is endowed with *life,* while circulating, is perhaps a stretch of the mind; but the difficulty arises merely from its being a *fluid,* the mind not being accustomed to the idea of a *living fluid.* Let us, however, weigh the question well, for it is not less difficult for a man born in the West Indies to conceive water as a *solid.* I recollect a person from Barbadoes, walking out with me early one frosty

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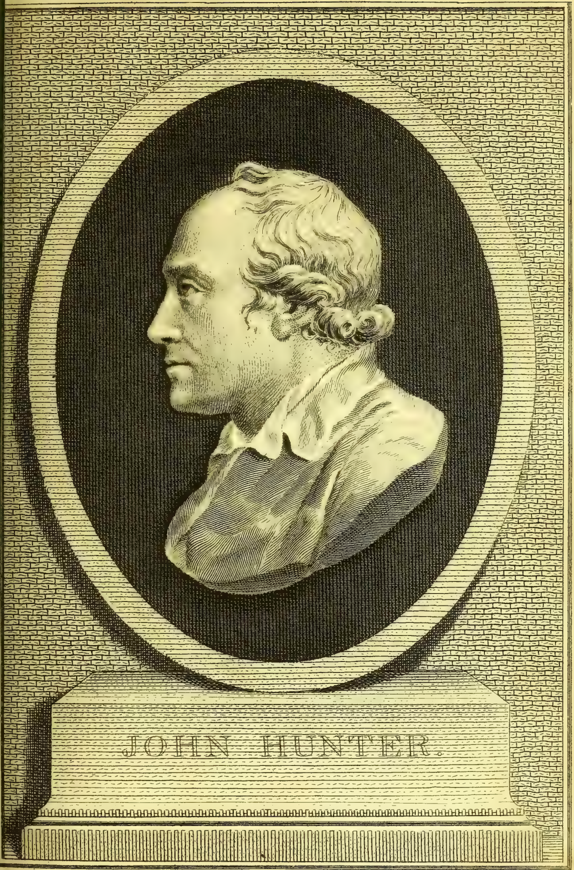
* HUNTER, like HARVEY, presents us with many indications of a great and original mind: he had acute discernment, unwearied application, original remark, bold inquiry, and a clear, forcible, and manly reasoning, and his name is deservedly illustrious on account of the many observations and improvements he made in anatomy and physiology: and every one who considers the surprise which his doctrines excited among medical men of his day, and the strong opposition they met with, will allow that the opinions he held were novel, or appeared at that time new, which entitles him to the first rank in the class of eminent discoverers, ancient or modern. The doctrines of *Pneumatic Medicine,* a most extraordinary circumstance! may be found throughout his works, and, like meteors, they often shine forth amid the thick gloom that then pervaded physiology.—Once, speaking to the author of this work on the subject, HUNTER said, "Whoever shall hereafter investigate the operation of the dephlogisticated "*(Vital)* and other airs, in the animal œconomy, apply the same, and "will pursue my ideas of the *vitality* of the blood, he will become a "benefactor to mankind, and his name will be immortal."

† Vide his Work on the Blood, from which this section is taken nearly *verbatim.*


JOHN HUNTER.

Engraved by J. Caldwall, after a Model done from the Life by Mr. Tassie.

London, Pub. by Sherwood, Neely, & Jones, 1813.

morning, and I observed to him ‘ It was a frost.’ He immediately caught up the strange word frost, and asked me how I knew it was a frost. ‘ Because,’ says I, ‘ I see ice.” He asked ‘ where.’ Having shewn him an icicle, he could not believe it had been water, and put his finger upon it, and with such caution, as bespoke a mind ignorant of what he had to meet; and feeling resistance he drew his hand back; then looking at the ice, he grew more bold, broke it, examined it, saw it melt, and believed it to have been water. Thus when all the circumstances attending the blood are fully considered, the idea that it possesses *life* will be easily comprehended.

“ First, *living matter has the power of resisting putrefaction.* Our ideas of life have been too much connected with organic bodies, and principally those endowed with visible action, hence it requires some reflection to be convinced, that these circumstances are not inseparable. I was led,” says the illustrious Hunter, “ to this notion in the year 1756, when I was observing the process of incubation. I then noticed, that whenever an egg was hatched, the yolk was always perfectly sweet to the very last; and that part of the albumen, which is not expended in the growth of the animal, some days before hatching, was also sweet, although both were kept in a heat of 103° in the hen's egg for three weeks, and in the duck's for four. I observed, however, that if an egg did not hatch, it became putrid, like other dead animal matter. It is thus with the *blood:* while alive in the body, at the temperature of 97, it resists putrefaction; but when drawn from a vein, it then putrefies like other dead animal matter.

“ Secondly, *living matter has the power of resisting the operation of cold.* Having put a new laid egg into a cold about 0, I imagined that the preserving power of life was destroyed by such a degree of cold. I then put this dead egg, as I shall call it, with one newly laid, into a freezing mixture. The former was frozen seven minutes before the other.

" A new laid egg was put into a cold of 15°, it took half an hour before it was frozen, but when thawed, the same being placed under similar circumstances, took only a quarter of an hour, and the same experiment was repeated with nearly the same result.

" Similar experiments were made with the *blood.* After a portion of blood had been frozen, and then thawed, it has again been frozen with a similar quantity of fresh blood drawn from the same person, and that which had undergone this process, froze again much sooner than fresh blood.

" I observed, in like manner, that the sap of trees would freeze at 32° when taken out of the vessel of the tree, but the same was not frozen when the heat of the tree stood often so low as 27°.

" Thirdly, *the blood obeys the same laws as the living solids.* The following experiments were made on living muscles, to see how far the *contractions* of living muscles, after having been frozen, corresponded with the *coagulation* of the blood.

" From a straight muscle in a bullock's neck, a portion, three inches in length, was taken out immediately after an animal had been knocked down, and was exposed to a cold below 0, for fourteen minutes. At the end of this time it was frozen exceedingly hard, was become white, and was two inches long. It was now gradually thawed, and in about six hours after thawing, it was contracted so as to be only one inch in length. Here then were the juices of muscles frozen, so as to prevent all power of contraction in their fibres, without destroying their life, but when thawed, they shewed the same contractile power as before.

"This is exactly similar to the freezing of *blood* too fast for its coagulation, which, when thawed, does afterwards coagulate. To prove this by experiment, I took a thin leaden vessel, with a flat bottom, of some width, and put it into a cold mixture below 0, and allowing as much blood to run from a vein into it as covered its bottom. The blood froze immediately, and when thawed, became fluid, and coagulated, I think, as soon as it would have done had it not been frozen.

"In the spring of 1776, I observed, that the cocks at my country house had the combs smooth with an even edge, and not so broad as formerly; appearing as if nearly one half had been cut off. Having inquired into the cause of this, my servant told me, that it had been common during that winter. He observed that the comb of one cock being frost-bitten, had entirely dropt off. I endeavoured to try the solidity of his remark by experiment.—I attempted to freeze the comb of a very large cock, and succeeded in freezing the serrated edges, which were fully half an inch in length. The frozen parts became white and hard, and when cut through, neither did it bleed, nor the animal shew any signs of pain. I next introduced into the frigorific mixture one of the cock's wattles, which was very broad and thin. It froze very readily, and upon thawing both the frozen parts of the comb and wattle, they became warm, but were of a purple colour; the wound in the comb now bled freely; both comb and wattle recovered perfectly in about a month, the natural *florid* colour increased gradually, until the whole had acquired an healthy appearance.

"Finding that freezing both the *solids* and the *blood* in them did not destroy the life in either*, nor the future actions of the vessels, and that also it did not prevent the blood from recovering its *fluidity*, I conceived that the life of both solids and fluids are *similar*, and what will effect the one, will effect the other also, though probably not in an equal degree; for in these experiments the blood was under the same circumstances as the solids, and retained its life; that is to say, when the solids and blood were frozen, and afterwards thawed, they both afterwards were capable of carrying on their functions, and were not rejected as extraneous bodies.

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* Leeches may be frozen quite stiff in ice, and when gradually thawed, they become as vivacious as ever.

" It is to me somewhat astonishing, that the idea of the *vitality* of the blood did not early strike medical inquirers, considering the stress which they have laid on the appearance of this fluid in diseases; since this fluid was expressive of disease more than any other part of the animal œconomy, and yet all these changes must have arisen from, what shall I term it? a *dead* animal fluid, on which disease had such an extraordinary power.

" While the blood is circulating, we know it has the power of preserving its *fluidity*. This is not produced by motion alone, for in torpid animals, when almost in a state of death during the winter, when the blood is moving with extreme slowness, and would appear to preserve simply animal life through the whole body, the blood does not *coagulate*.

" Now, as the *coagulation* of the blood appears to be that process which may be best compared with the *action of life* in the solids, we will consider this property a little further, and see if this power of coagulation can be destroyed; if it can, we shall next inquire, if by the same means life is destroyed in the solids, and if the phænomena are nearly the same in both.

" As the heat of 120 degrees excites the blood to *coagulate*, I wished to try how far *muscular contraction* was similar in this respect. I took a piece of a muscle from a sheep newly killed, and put it into water heated to 120 degrees, when it contracted directly, so as to become hard and stiff.

" Animals killed by lightning, and also by electricity, have not their muscles contracted, in such cases the blood does not coagulate. I saw two deer, who were hunted until they dropt down and died ; in neither did I find the muscles contracted, nor the blood coagulated. Blows on the stomach kill immediately ; and the muscles do not contract, nor does the blood coagulate.

" In the West India islands they kill their poultry with vegetable poisons, in order to render them tender without keeping, in which case the blood does not coagulate. For the same reason, the expedient was devised to satisfy shameful gluttony, namely the flogging of animals to death.

" The general debility, and laxity of the muscles, brought on after repeated venesection, and the great prostration of strength, and even death, produced by hæmorrhage, when the evacuation of the blood is considerably and suddenly made, must be considered as a strong proof, added to the thin state of the blood, of the living principle being inherent in the blood, and of its having a similar nature as the muscular fibres.

" On the contrary, in diseases where the action of the heart was going on very strong, the muscles after death contract strongly, and the blood strongly coagulates. This *coincidence* of *coagulability* in the *fluids*, and *contractility* in the *solids*, that is, both *shortening their dimensions, and being obedient to the same laws*, clearly proves that they both depend on the *same cause*.

" The living principle, therefore, in the *blood*, which I endeavoured to shew to be similar to the living principle in the *solids*, owes its existence to the same matter which belongs to the other, which is the *materia vitæ diffusa*, of which every part of an animal has its proportion; it is as it were diffused through the whole *solids* and *fluids*, making a necessary constituent part of them, and forming with them a perfect whole; giving to both the power or susceptibility of impression; and, from their construction, giving them consequent reciprocal action."

SECTION XV.

THE VITALITY OF THE BLOOD IS DERIVED FROM THE AIR.

"The *life* of the animal then," says Hunter, "arises from the *blood*; but the *blood* itself must be kept *alive*. Whence then the *life of the blood*?

"To accomplish this it must have motion to and from the heart; from the heart it is supersaturated, if I may be allowed the expression, with the *living principle*, with which it parts as it visits the different portions of the body.

"This *living principle* in the *blood*, which, says Hunter, I have endeavoured to shew was *similar* to the *living principle* of the *solids*, owes its existence to the *same matter* which belongs to the other, and is *that principle* of which every part of an animal has its portion; it is diffused through both solids and fluids, making a necessary constituent part of them, and forming the perfect whole, giving them both the power of preservation from putrefaction, and from cold, and susceptibility of impression, which keeps up the harmony betwixt the fluids and solids, and accounts for that reciprocal influence which each has on the other."

" The *materia vitæ diffusa*, this *universal living principle*, is not, I conceive, derived from the energy of the *brain*, or from *nerves*, for if nerves, either of themselves, or from their connection with the brain, gave *vitality* to our fluids and solids, how should the circulation continue, and the solids be alive, after a nerve was destroyed? or still more after paralysis? for the limbs continue alive, blisters draw, wounds heal, parts are nourished, though robbed of voluntary action and feeling; but deprive them of their blood, by tying the arteries, and the parts immediately mortify.

" We are come now more particularly to the consideration, *Whence this living principle?*

" We are led by daily experience to observe, that the dark blood taken from a vein becomes red on that surface which is exposed to the *common atmosphere*, and that if shaken in a phial with air, the whole becomes red, but *in vacuo*, however shaken, there is no redness. Thus if blood be allowed to stand exposed to the air, and coagulate, its upper surface will become of a scarlet red, while the bottom remains dark. If the coagulated blood be inverted, and the bottom, which has been turned upwards, be exposed to the air, this part will also assume the scarlet red.

" The red will even penetrate some depth, and even pervade a moistened bladder; so that if venal blood be received into one, and it coagulates, the whole globe will be one uniform scarlet on the outside, as may be proved by cutting any part of the bladder.

" We find also by experiment, the vessels in the lungs being full of blood, are of a dark colour when the trachea is tied; but upon inflating the lungs, the cells will instantly contain florid blood, the small vessels pervading those cells, whether arteries or veins, having the modena colour of the blood immediately changed by the air passing through their coats.

" The scarlet blood is therefore that blood which has imbibed *air* in the lungs, and passes into the arteries, where it is more commonly seen ; hence it is called arterial blood, and the modena, or lake, is the venal blood of the body, as also of the pulmonary artery of the lungs. This is so well known that there need hardly any proof of it. I bled a man, continues Hunter, " in the temporal artery, and in a vein of the arm at the same time. The blood was received into different cups. The blood of the artery was of a florid red, that from the vein was dark.

" To prove that this florid colour arises in the living animal from the absorption of *air* in *breathing*, I fixed the nozzle of a bellows into the trachea of a dog, and immediately began artificial breathing. I then removed the sternum and cartilages, and opened the pericardium. While I continued the artificial breathing, I observed that the blood in the pulmonary veins and aorta was either crimson, or modena, just as I threw air into the lungs, or not. I next cut off a piece of the lobe of the lungs, and found that the colour of the blood which came from the bleeding wound corresponded with the experiment above. When I threw air into the lungs, the pulmonary veins and aorta looked red, and scarlet blood issued from the wound ; and when I desisted from throwing in air, the blood passing from the wound was of a dark colour.

" I bled a gentleman in the temporal artery, while in a fit of apoplexy ; he breathed at that time seemingly with great difficulty, the blood flowed freely, but was of a dark venal character ; he soon after was relieved, his breathing became free, and the blood from the temporal artery now flowed as crimson as ever.

" Mrs.——, of Norris-street, Haymarket, fell into an apoplectic fit, in which she was insensible : the breathing was short, attended with a rattling of the throat, and a snorting.

I judged it right to open the temporal artery, and it bled freely; and I observed, that while her breathing was difficult, or when she hardly breathed at all, the blood was modena: and when she breathed easier, the blood became immediately scarlet, and this alternated several times in the course of the bleeding.

" A. B——, when a boy, could never use the same exercise as other boys; he could not run up stairs, nor ascend a hill, without being out of breath. Upon the least motion he had palpitation of the heart, which was so strong as to be heard by those near him; but his becoming so soon fatigued was supposed by his acquaintance to be owing to a want of spirit. While a child, crying would bring on palpitation, and suffocation; and as suffocation always arises from a want of the due influence of pure air on the blood, while the circulation was going on, the whole body must change from the scarlet tinge to the modena or purple, as was the case, and in particular shew itself in those parts where the blood imparts its colour most, as in the face, lips, fingers' ends, &c. Nevertheless he grew to be a well formed man, but he still retained those defects, which, indeed, rather increased as he enlarged his views, and with them his actions. He consulted several physicians. The difficulty of breathing, the great oppression, the blackness in the face, I suppose they thought arose from spasm, or was nervous, for they ordered cordials, as spirit of lavender, &c. I was consulted next. Upon investigating all the symptoms, my opinion was, that there was something wrong about the construction of the heart; that in consequence the blood not flowing freely could not have the proper influence of the air in the lungs, hence the reason of the darkness or lividness of the complexion when attacked upon using more exercise than was proper. He was directed, as he could hardly use any exercise of his own, to have motion given him, such as riding in a carriage, and with great care he was directed to suppress such actions as he found from experience brought on these fits of suffocation. He was to lose a little blood at the time of attack; but all these precautions hardly kept him tolerably well. At length other disorders supervening, he died, and I had the satisfaction of opening the body. I found the viscera sound, but upon examining the aorta, as it passes from the left ventricle of the heart I found the aorta, and its three semilunar valves, *ossified.* This diseased state of the aorta, and its valves, accounts for every one of his original symptoms, and as such afford very little use to the practitioner in order to accomplish a cure; the blood there, upon any unusual extension, must have fallen back into the ventricle, and have overloaded the heart, impeding the circulation, and consequently the necessary change of blood in the lungs.

The vast number of cells into which the lungs are divided, the whole arterial and venal system ramifying on the surface of those cells, and of course the whole of the blood passing through them in every circulation, together with the loss of life upon missing three or four breathings, shew the power of the *air* upon the blood for the purposes of life; and the time we can live without breathing, being shorter than that in which we can die from a defect in any other natural operation, all seem to prove, that the *air* somehow bestows life on the blood, and the blood continues it, by imparting this same vital principle to every part of the body. Hence it is to the *atmosphere* (or rather to that particular part of it which goes by the name of *vital* or *oxygen air*) that we are indebted for *that vitality* which is communicated to the *blood*, and which *animates* our *bodies*, and is the immediate bond of union betwixt our immaterial soul and this visible world.

We may be compared to small pieces of feather placed upon an electrical machine, which while the handle is turned, dances upon the conductor, but the moment of cessation, they all drop: so we are supported upon this solid globe, and each plays his part; but were once the air to be removed we should immediately fall down, as those stricken in the deserts of Arabia by the Hattan or scorching wind.

"*Respirable air*," says John Hunter, "has the property of heightening the red colour of the blood to a scarlet; and *this*, with its consequent *heat*, is supposed to be the chief or only use of *respiration*:—but if we suppose the change of colour in the red globules to be all that *respiration* is to perform, we shall make the *red globules* the most essential part of the blood, whereas that may be said to be the least. It is most probable, that *the effect* of *air* on *the blood* is greatest on the *coagulable lymph*; and this conjecture is rendered more likely, when we consider, that in cold animals, which have no red globules, *respiration* is as essential to their existence as in any other.

"Having at hand some water from the hot-well at Bristol, which I had found to contain *air* in a state of great purity, I completely filled a large phial of it, and I put into it a few very small fish, which I had provided for the purpose of these experiments. They were minnows, and other small fish about two inches in length. In this water they were confined without any access of common air till they died.

"After this I took equal quantities of the water in which the fish had died, and of that out of which it had been taken, where they were confined in; and I expelled from both all the air which they would yield. That from the water in which no fish had been put, exceeded in quantity that from the water in which they had been confined, in the proportion of 3 to 2; and examining the quality of both these quantities of air, by the test of nitrous air, the former exceeded the latter in a still greater proportion.

"The air from the water in which no fish had been confined was at the standard of common air, but that which had been contaminated by the respiration, as I must say, of the fish, was something *worse* than air in which a candle just goes out.

"From this experiment it may be concluded with certainty, that *air* contained in *the interstices* of water, is as necessary to the life of *fish* just as *air* in its *aeriform state* is to that of all *land animals*.

"*The blood, therefore, possesses vitality in all its parts; and this vitality, which it communicates to the solids, is derived from the oxygen of the air.*"

SECTION XVI.

ON IRRITABILITY.

Among modern physiologists, the very celebrated Baron de HALLER is considered as the first who clearly pointed out the existence of this principle in animal bodies, and proved it to be the cause of muscular motion; yet the merit of the discovery undoubtedly belongs to GLYSSON, who wrote a long time before him. It is a singular circumstance, that the English philosophers first discover, and foreigners afterwards run away with the honour.

In Glysson's work, *On the Stomach and Intestines*, a whole chapter is dedicated to the consideration of this subject. It is entitled *De Irritabilitate Fibræ.* He there establishes the distinction between the principle of irrita-

BARON DE HALLER.

J. Caldwall Sculp.

London, Pub. by Sherwood, Neely & Jones, 1813

bility and the nervous energy, and ascribes the action of the heart, and arteries, and the peristaltic motion of the intestines to the influence of the former. "The action of "the heart," he says, "is neither caused nor altered by "sensation. The fibres of the heart, by virtue of the im-"pulse of the vital blood contained in the ventricles, are "repeatedly irritated and exerted to contraction and "pulsation, and the irritation being quickly removed, "they are relaxed and return to their natural position."—In another place, he ascribes the convulsive motion into which the muscles of animals are thrown, upon the application of acrid liquors, to this subtle influence; he takes notice that the motion of many muscles continue during sleep, and after decapitation, when all feeling is abolished, and accounts for the phænomena by supposing them to be possessed of irritability. The only thing which renders his doctrine in any degree obscure, and which has probably given rise to the commonly received opinion that his ideas on the subject were not clear, is an expression which he often employs. He makes use of the terms *perception* and *perceptible,* to denote that property of the muscles by which they receive the action of a stimulus, and which we express by the word *irritable:* but he takes much pains to establish an accurate distinction between the perception of the nerve, of which he also speaks, and the perception of the irritable fibre, calling the first *perceptio sensitiva,* and the other *perceptio naturalis.*

Haller prosecuted this subject much further than Glysson did, and by the force of the facts on which it was founded, the reputation which he himself enjoyed, and the respect paid to his authority, the hypothesis was soon spread through all the schools of Europe. But it was not received in all of them with equal readiness. It was contended that the principle was the same with that of the nerves, and it was therefore supposed that *muscular* action depended on sensation. The muscles, it was imagined, *felt* as it were the stimuli which were applied to them, and it was in consequence of this feeling that they contracted. Glysson and Haller, and their adherents, were induced to think that there was a *vis insita* in muscles, (irritability): the others contended that there was not any *vis insita*, but that muscular motion, as well as feeling, depended entirely on the nervous energy *(vis nervosa)*.

It was mentioned as a fact, in favour of this last hypothesis, that muscles were thrown into action equally well when the nerve or nerves leading to these muscles were irritated, as when the stimulus was immediately applied to their own fibres. If it was asked, upon what principle it was to be explained, that the muscles of animals from which the sensorium had been removed by decollation, continued to move for many hours afterwards, as in beheaded frogs, turtles, newtes, &c.? it was answered, that in them the nervous power was slowly expended, and that as long as any of it remained in a nerve, so long could the muscles move to which that nerve was sent.

Leaving these objections to be answered by the phænomena of irritability which are immediately to be taken notice of, let it be remarked, that, if in the examination of the question we were to confine our observations to the appearances that occur in perfect animals, we should, perhaps, never arrive at the truth, since in them nervous and muscular matter are intimately blended together in the greater number of irritable parts. The finest needle when thrust into any muscle of a living animal, is acutely felt: how then is it possible to determine whether the phænomena which take place in consequence of the puncture, be owing to a peculiar *vis insita* inherent in them, or to the nervous energy? But in extending our view to the rest of the organized world, such a number of facts present themselves as are sufficient to bring conviction to the mind of any impartial man.

If it can be discovered that there are many organized bodies possessed of a faculty of motion which is totally distinct from that produced by mechanical impulse, or chemical attraction, inasmuch as it is only peculiar to them during their living state, and that this motion is excited by the application of stimuli; that it follows the same laws with animal motion; is augmented by the application of additional stimuli, and diminished by withdrawing the same, and is evidently affected by the health of the organized body itself; and further, if it be proved that these bodies, possessing such motion, have no brain or nerves, or any thing which has a resemblance to them, then it follows, as a necessary deduction, that there is a principle of motion (irritability, or whatever other name may be given it,) distinct from nervous energy, and also distinct from the principle of mechanical motion.

It is among the vegetables, and lower class of animals, that the organized bodies alluded to are principally to be found. The stamina of the barberry when pricked by a pin, or any other fine sharp instrument, are immediately thrown into evident motion: when the leaves of the *averrhoa carambola* are touched, they draw themselves together; those of the *mimosa pudica*, or sensitive plant, do the same thing, either when stimulated by the touch, by electricity, or by ammonia. The leaves of the plant called Venus's fly-trap (Dionæa muscipula), are beset on their edges with sharp prickles: these leaves are endowed with a considerable portion of irritability, for when an insect crawls between them they immediately close themselves, and squeeze the little animal to death. Any person possessed of this rare plant may easily convince himself of its powers; for by irritating the inside of the leaves with a piece of straw, or grass, the motion is immediately produced. The moving plant, *(hedysarum gyrans)* is possessed of evident motion; it is excited by the stimulus of the rays of the sun: for as soon as these fall upon it, its leaflets immediately commence their motion, and when the plant is withdrawn from the solar light, the motion ceases. Many others beside these already enumerated, are endowed with a faculty of motion in an eminent degree such as the *oxalis sensitiva, onoelia sensibilis,* the *drosera rotundifolia,* and *longifolia,* &c.

Irritability is one of those grand truths which is undeniably demonstrated: and *Posterity,* which alone stamps the merit of discoveries, *by abstracting of persons,* will promote *this discovery* to that rank, which its USEFULNESS entitles it to. She will laugh when she observes, that after its opposers had failed in persuading us there was *no such thing,* they should endeavour to render the doctrine *odious,* by the consequence which they pretend naturally follows from it. She will be diverted to see Physicians following the example of religious Sectaries and Devotees, interesting the cause of GOD with *theirs,* and accusing of *materialism,* such as differ from them in opinion as to the pulsations of the Heart, and motion of the other organs. A certain author, well known for the greatness of his talents, and the bad use which he made of them, has endeavoured to draw *this induction*; but the illustrious De Haller, who was seriously affected at the imputation, has ably refuted the futility of such impious and absurd reasoning.

It is observable, that the motion of the HEART not only survives that of the organs of voluntary motion, but continues a considerable time even after it is separated from the body. Nay, after it has even ceased to palpitate, yet as it still retains a latent power of contraction, its systole and diastole may, by the application of stimuli, be alterately renewed and continued some time longer. Hence in drowning or suffocation, though the pulse be imperceptible, and life apparently extinguished, yet the heart still preserves this latent power or susceptibility of motion; for though unable to propel the blood through the vascular system, yet it wants only to be gently excited by suitable stimuli to renew its action.

In the first rudiments of animal life, even before the brain is formed, the *punctum saliens* points out the embrio heart in miniature, and marks its *primæval irritability* as a sure presage of vitality.

The heart of the chick begins to move, before we dare presume, that there is any organ for distributing the nervous power. The *punctum saliens* is the heart of the chick; it is seen beating while the body of the chick is but a rude, unformed, and gelatinous mass.

As this singular organ exhibits *irritability* the first, so it never relinquishes it till the last, and may therefore be considered as the *primum mobile* and *ultimum moriens* of the animal machine.

In animals with cold blood the *irritability* is very great, and continues a long while. The heart of a *viper* will palpitate when taken from its body twenty-four hours, and that of a *turtle* thirty or longer; and in animals whose blood is hot it moves until the fat is rendered stiff by the cold, at which time the motions of the heart and all the other muscles commonly cease.

The celebrated Boerhaave acknowledges an active force in the *heart*, and a latent principle of motion in the pieces of it when cut, but he nevertheless attributes this to the *nerves*, though the communication with the brain has been cut off! Dr. Whytt follows the same path, but with this difference of expression, he uses the term *irritability*, and imputes it to the *soul*, which feeling the impression of the *irritation* occasions the contraction of the fibre, the *soul* therefore with him is *devisible*, and resides in *every living part* of the body! Accordingly we find also, in other books, "All motion is owing to the *soul*, which being "sensible of stimuli contracts the fibres which are "touched, and pulls them back, to prevent their being "injured *."

However simple this theory may be, and, like the doctrine of *Phlogiston* among the chemists, however *commodious* for disembarrassing us from several difficulties, yet as it is not in unison with the phænomena that are observed, it must be rejected.

1. For, in the *first place*, the most *irritable parts* are those that are *least sensible*, and therefore are not subject to the command of the soul, which ought to be quite the reverse, if the *soul* was the principle of *irritability*.

2. In the *second place*, *irritability* continues *after death*, and in parts quite *separated* from the body, and *deprived* of its *communication with the brain* †, for there is nothing more common than to see the heart of a frog beat, and the muscles remain irritable, after the head has been taken off, and the spinal marrow removed.

3. And *thirdly*, it is generally allowed, that the *nerves* are the organs and the *brain* the receptacle of all our sensations, the sources of all our ideas; but the *nerves* and

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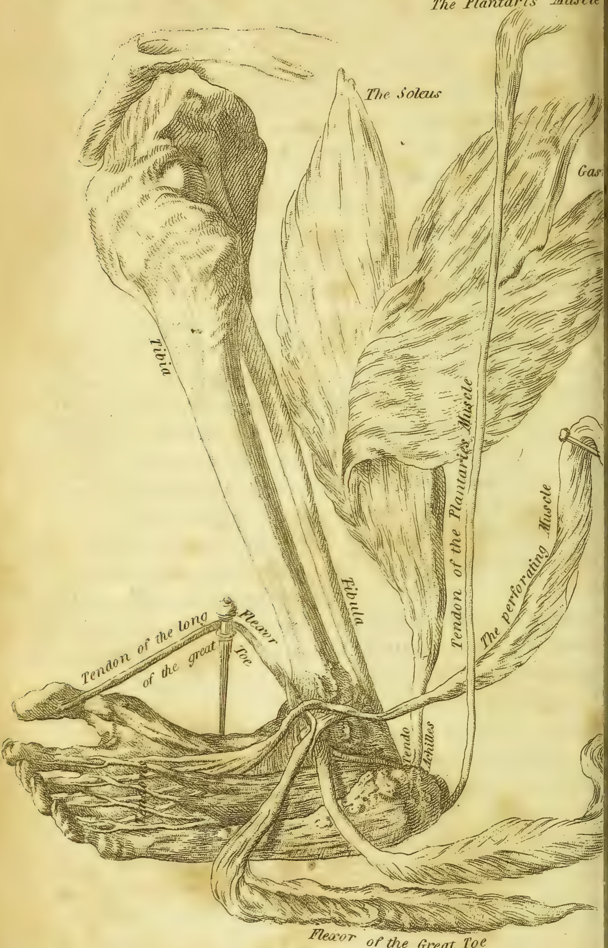
* This is the *Vis Medicatrix* of the old Physicians.

† The heart is observed before the brain in the embrio chick, and is supposed therefore to act independent of brain. Some children have grown their full period in the womb, where there has been found after birth *no brain*. Might not *irritability* during the fœtal period serve all the purposes of *this vegetative life?* but as soon as the infant is brought into the world, where voluntary motion and sensation is required, a state *advanced above the vegetable*, the babe *without a brain* instantly perishes.

Muscles with their Tendons.



London, Pub. by Sherwood, Neely & Jones, 1813.

the *brain*, as will be presently shewn, *are not irritable*, therefore *irritability has nothing in common with sensation*.

The ARTERIES have been always supposed to be *irritable*. This idea is countenanced, *first*, by seeing that the silk-worm has no heart, but only a large artery, which performs the office of a heart. *Secondly*, by the blood after death being expelled, whence these derive their name *; and *lastly*, by the motion of the fluids continuing, as may be seen in a microscope, even when the heart has been removed. Unless this was the case, the *pulse* of the arteries, which resembles the systole and diastole of the heart, will be very difficult to be accounted for.

The LACTEALS contract and empty themselves like the *arteries*, upon being touched with *vitriolic acid*, and there is the *same argument* for their being *irritable* as for the *arteries*, viz. though they be ever so full of chyle at the time when the animal dies, they empty themselves, and contract in such a manner, that you cannot discover any fluid within them in the *dead* animal.

MUSCLES are composed of longitudinal fibres which shorten themselves, and are so disposed that this contraction always serves some wise purpose. They elegantly terminate in tendons, which are braced by sheaths, and though so numerous, each occupies its proper place and just direction.

Colour was believed to be essential to the constitution of a *Muscle*. But in fowls, in amphibious animals, in fishes, in worms and insects, through all the gradations of animals, of different species, of different sizes, the colours of the muscular fibre change. In fishes, and in insects, it is generally white ; even in the human body, it is not essentially red; the fibres of the iris, and the muscular coats of the arteries, the muscles of the stomach, of the intestines, and of the urinary bladder, are colourless. We cannot therefore define a muscle by that property which it often wants; but we may, with the utmost propriety, characterize it by its *contractile power*, the only true evidence of its nature; for the contraction of the iris proves it to be a muscle by truer marks than its colour; and by the same rule the muscles of a fish, or of the meanest insect, are as perfect as those of man.

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* *Arteries*, from αερ, air ; and τραω, to draw.

Such is the connection betwixt muscles and their *contractile force*, or PRINCIPLE of IRRITABILITY, that the moment it dies, all its astonishing power is gone; and the muscle which could lift an hundred pounds while *alive*, can bear the weight but of a few pounds when *dead*. Whereas, on the contrary, all those parts that are *inirritable*, as the ligaments, tendons, &c. are capable of bearing the same weight when *dead* as when *alive*.

This *irritable*, or *contractile power*, in muscles, is that property by which muscles recede from certain stimuli, without any feeling, without creating any consciousness of action, and so little dependant is it upon nerves, that it is found equally perfect in *animals* * and *plants* which have no nerves, and remains in parts severed from the body to which they belong, This *irritability* is so far independent of nerves, and so little connected with feeling, which is the province of the nerves, that upon stimulating any muscle by touching it with a caustic, or irritating it with a sharp point, or driving the electric spark through it, the muscle instantly contracts: although the nerve of that muscle be tied; although the nerve be cut so as to separate the muscle entirely from all connection with the system; although the muscle itself be separated from the body; although the creature upon which it be performed, may have lost all sense of feeling, and have been long to all appearance dead. Thus a *muscle* cut from the limb, trembles and palpitates long after: the *heart*, separated from the body, contracts when irritated; the *bowels*, when torn from the body, continue their peristaltic motion, so as to roll upon the table, ceasing to answer to stimuli only when they themselves become actually dead. Even in *vegetables*, as in the sensitive plant, this contractile power lives. It is by this *irritable principle*, that a cut *muscle* contracts and leaves a gap; that a cut *artery* shrinks and retires into the flesh. Even when the body is dead to all appearance, and the nervous power gone, this contractile power remains; so that if a body be placed in certain attitudes, before it be cold, its *muscles* will contract, and it will be stiffened in that posture till the organization yields, and begins to be dissolved. Hence comes the distinction betwixt the *irritability* of the muscles and the *sensibility* of nerves; for the *irritability* of muscles survives the animal,—as when it is active after death;—survives the life of the part, or the feeling of the whole system, as in palsy, where the vital motions continue entire and perfect;—and where the muscles, though not obedient to the will, are subject to irregular and violent action;—and it survives the connexion with the rest of the system, as where animals very tenacious of life are cut into pieces: whereas *sensibility*, the property of the nerves, gives the various modifications of sense, as vision, hearing, and the rest; gives also the general sense of pleasure or pain; and thus the eye feels, and the skin feels; but their appointed stimuli produce *no motions* in these parts; they are *sensible* but not *irritable*. The *heart*, the *intestines*, and all the *muscles* of voluntary motion, answer to stimuli with a quick and forcible contraction; and yet they hardly feel the stimuli by which these contractions are produced, or at least they do not convey that feeling † to the brain.—There is no consciousness of present stimulus in those parts which are called into action by the impulse of the nerves, and at the command of the will: so that *muscular parts* have *all the irritability* of the system, with but *little feeling*, and that little owing to the nerves which enter their substance; while *nerves* have *all the sensibility* of the system, but *no motion.*

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* The polypus, according to John Hunter, is devoid of nerves.

The nervous influence is a mere stimulus to the voluntary muscles, as blood is to the heart and arteries; food to the stomach; or bile to the intestines. It loses its influence over the system sooner than the irritable principle in the fibre fails: for the irritable state of the muscle continues long after the voluntary motion, or power of excitement from the nerves, is gone; for when we die *slowly*, the irritable principle of the muscles is exhausted in the struggles of death. If, while in perfect health, we are killed by a *sudden blow*, the irritable power of the muscles survives the nervous system many hours or days, and the flesh trembles, and the absorbents continue to absorb; and often, as after suffocation, or drowning, we can, by operating upon this poor remains of life, restore the circulation, re-animate the nervous system, and recover that life which seemed to have entirely left the body; and thus the nervous influence, which seemed to animate the system, and to be the prime mover and source of life, owes its restoration to that, which was conceived to be but a secondary power.

Baron de Haller found that the Diaphragm was the most irritable muscle, contracting upon being pricked even an hour after the intestines had ceased to act.

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† The cause of this curious phænomenon we shall particularly explain, when we come to treat of *ganglions*.

The Æsophagus, or gullet, was extremely irritable; as also the stomach and intestines.

But the gall-duct was inirritable; as also the lungs and pleura, the liver, kidney, and spleen.

The sensible parts, or those that produced pain when wounded, were found by him to be, the Cerebrum, Cerebellum, and Medulla Oblongata; the Spinal Marrow, the Nerves, the Skin, the internal Membranes of the Stomach, Intestines, Bladder, and Ureters, the Muscles, and Breast.

The insensible parts are, the Dura Mater, Pia Mater, Periosteum, Peritonæum, Pleura, and Pericardium; Mediastinum, and Omentum; the Cuticle, the Rete Mucosum, Tendons, the Capsule, Ligaments, and Bones; the Marrow, Teeth, and Gums.

The living parts of the system are the muscles and nerves; the *muscles* to move the body, and perform its offices, each muscle † answering to its particular stimuli, and most of them obeying the commands of the will; the *nerves* to feel, to suffer, and to enjoy, to issue the commands of the will, bringing the muscles into action: but still the muscles have their own *peculiar life*, or *irritability*, superior to the nerves, and independent of them. It is a power which survives that of the nerves, acting even when severed from the general system; and acting often on the living body, without the impulse of the nerves, and sometimes in opposition to the will.

The insensible and inirritable matter of the system joins these living parts, and performs for them every subservient office,—forms coverings for the brain;—coats for the nerves;—sheaths for the muscles;—tendons,—ligaments,—and all the apparatus for the joints; unites them into one whole by a continued tissue of cellular substance, which has no interruption, and suffers no change, but still preserves its own insensible nature, while it joins the sentient and moving parts to each other. The tendons, ligaments, periosteum, and capsules of joints, are all composed of this cellular substance, which by its *elasticity*, binds and connects the parts, and by its dead and insensible nature, is less exposed to disease, and appears therefore to be the fittest medium of connection for the *living* system. To conclude,

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† Including the *hollow muscles*, as the heart, arteries, lymphatics, stomach, intestines, &c.

Baron de Haller, therefore, properly calls that a SENSIBLE PART of the human body, which, upon being hurt, transmits the impression to the soul: or which, in other words, occasions evident signs of pain and disquiet in the animal. On the contrary, he calls that INSENSIBLE, which being burnt, tore, pricked, or cut till it is quite destroyed, occasions no sign of pain or convulsion, nor any sort of change in the situation of the body: and he calls that an IRRITABLE PART, which becomes shorter upon being touched; very irritable if it contracts upon a slight touch, and the contrary, if by a violent touch, it contracts but little.

We have therefore a *threefold division* of the human body into PARTS,

1. SENSIBLE;
2. INSENSIBLE; and
3. IRRITABLE †.

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† It is with some reluctance that I present to the humane Reader this useful detail of experiments on animals, though I think a better apology may be given for these, than for the *diversions* of hunting, fishing, and shooting, which are universally tolerated in civilized societies:—and, perhaps, the compassionate Reader, like those who do not object to the

As long as medical science was built, not upon the substantial basis of actual experiment, but imagined properties, assumed as data, it was changing every day its forms; for one fanciful opinion has always a right to supplant another. At length the sun of science arose, which dispelled those mists which obscured so sublime a science, by following the maxim of Bacon, wisely exclaimed, "Non fingendum aut excogitandum, sed inveniendum quid natura faciat aut ferat;" that the operations of nature were not to be fancied, but diligently scrutinized, and physiology was placed in a point of view the most respectable, being established upon actual observation and experiment.

SECTION XVII.

OF OXYGEN AS THE PRINCIPLE OF IRRITABILITY.

Dr. Beddoes suspects oxygen to be the principle of irritability, but if philosophers have not gone so far as to shew what the *irritable principle* is, they have discovered, at least, the *condition* of its *existence.*

They observe first, "*that every thing that increases the quantity of* oxygen *in organized bodies, increases at the same time their irritability.*"

A considerable quantity of very pure *oxygen air* was injected into the jugular vein of a dog. Upon opening the thorax and the pericardium of the animal, the heart was found *more irritable* than ordinary, and its alternate contractions and dilatations continued upwards of an hour,

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enjoyment of the fruits of these sports and pastimes, as they are improperly called, so may he peruse with some pleasure the conclusions drawn from the sufferings of nature, inflicted by man on animals, from the more *exalted motive* of *philanthropy.*

The *right auricle* of the heart was vermilion, and it contained, as well as the *right ventricle*, a great quantity of blood of a bright vermilion colour. The blood contained in the *left auricle*, in the *left ventricle*, the *aorta*, and the *arteries*, was of a bright rose colour, and mixed with bubbles of air.

All the muscles were *more irritable* than ordinary.

After the blood contained in the heart and arteries was discharged, the *irritability* of the heart and muscles was sensibly diminished.

This experiment proves, most decisively, that the *vermilion* colour which the blood assumes in passing through the lungs is not owing to *the loss* of *charcoal* and *hydrogen*; but that it proceeds from *the combination* of the blood with the *oxygen air.*

In the experiment I have just now described, the livid colour of the venous blood in the *right auricle* and *ventricle* of the heart was changed to that of vermilion. Nevertheless it could not have *lost* any *carbon* or *hydrogen*: it therefore only *acquired oxygen* or *vital gas.*

This experiment is also a direct proof that *oxygen* favours *the principle of irritability*; for by *surcharging* the blood with *oxygen*, by *hyper-oxygenating* it, if I may use the expression, the *irritability* of the contractile fibre was, as we have seen, considerably *increased.*

The *irritability* also of persons made to breathe *oxygen air* is wonderfully increased, as is shewn by an universal increase of energy in the system. But what shews most clearly, that the *irritability* is always *in proportion* to the quantity of *oxygen* in the system, are the phænomena attending the action of *mercury* and *mercurial oxyds* upon animals. As this is one of the most striking proofs of this theory, and as many persons, and amongst the rest, philosophers of the first rank, such as Dr. Crawford, have been struck with the novelty and simplicity of my mode of explaining these phænomena, I cannot forbear, says he, entering into some detail upon this subject.

It is a well known fact among physicians, that *mercury*, in its *metallic state*, has *no effect* upon the human body. I have known many people, who for many years have taken a daily portion of quicksilver, to the amount of one or two ounces, but who never perceived any effect whatever from this singular and ridiculous custom. It is proved also by the experiments of Dr. Saunders, that the effects of mercurial ointment are owing only to the small quantity of mercury that has been *oxydated* during a long trituration. It is necessary, therefore, that mercury should be oxydated, to have any effect on the human body. Besides, it is well known that in persons who have rubbed themselves with mercurial ointment, or who have taken the oxyd of mercury, the *mercury*, after having *produced* its usual effects, has passed through the skin in a *metallic form*, and has amalgamated itself with watches, and the gold in the pocket, &c. The oxyd of mercury, in passing through the human body, parts with its *oxygen*, and it is this *oxygen* alone, which remains combined with the system, that *the effect* produced by *oxydated mercury* is owing. Thus *arsenic*, under its metallic form, has no effect upon animals; but the *white oxyd* of this metal is one of the most terrible poisons; for it *hyper-oxygenates* the organized fibre with which it comes into contact, and reassumes its metallic form.

The cause of the beneficial effects of *steel* on the animal œconomy has not been hitherto sufficiently scrutinized. According to Mons. Chaptal, the red particles of blood almost wholly consist of *iron.* And it is well known that the blood acquires its florid colour from its exposure to the air in the vesicles of the lungs, from whence nothing but *vital air* is absorbed. It seems therefore probable, that the red particles of blood consist chiefly of particles of iron, calcined by the *oxygen*, or *vital air*, and reduced to the state of a red oxyd of iron. Hence it appears, that *chalybeates* will not only increase the quantity of red particles in the blood on which the stimulant and tonic powers of that fluid most probably in a great measure depend, but will enable it to decompose a larger quantity of air which is received in the lungs by respiration, and thus occasion a greater evolution of heat, and will produce the same effect upon the system, as if a much purer atmosphere had been breathed for some time *.

By various experiments of Dr. Hale's, compared with those of Dr. Ingenhouz, it is evident, says the celebrated author of a system of Therapeutics, that vegetables in summer, while they enjoy the sun, are incessantly decomposing water, and emitting from their leaves their *oxygen* combined with *caloric* in the form of *vital air*. And it is clear, that as long as water is supplied abundantly, they not only preserve their vigour, even at mid-day with the most fervent heat, as in the south of Spain, but make a rapid progress in their growth, and emit a proportionable quantity of *vital air*. May we not infer from thence, *that their irritability depends on* oxygen, *and their vital energy on a plentiful supply of this reviving element*, whilst the *hydrogen* of the water not only supplies the combustible part of vegetables, but, by depositing its caloric, maintains the vital heat.

Were these facts well ascertained, it would throw great light upon the operation of these medicines in the human frame, and contribute to establish the system, now received by many, respecting *irritability*, as induced by *oxygen*.

2. "*Whatever diminishes the quantity of* oxygen *in organized bodies, diminishes at the same time their irritability*."

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* This consideration is taken up more at large in Vol. V. Sect XXXVII and XXXIX. on the medical power of oxygen, in our fifth edition.

A small quantity of *azotic air* was injected into the jugular vein of a dog. The animal died in twenty seconds. Upon opening the thorax, the pericardium, and the heart, —*the right auricle* and *ventricle* were filled with black blood. The *left ventricle* was of its ordinary colour. The heart, and almost all the muscles, had *lost* their *irritability* almost entirely; they contracted but weakly upon the application of the strongest stimuli, such as sulphuric æther, and the electric spark.

When consumptive patients breathe *azotic* or *hydrogen air*, blended with a small portion of *common air*, the circulation, irritability, sensibility, and appetite, is diminished, and the hectic fever is abated *.

There was long since a dispute between Dr. Whytt and Baron de Haller respecting *irritability*, and that dispute is not yet completely settled. The *former* attributed this power wholly to the *nerves*; the *latter* to the *muscular fibre*, independent of the nerves.

But were we permitted to reason from analogy, we might suspect, if not conclude, that since *plants*, by irritability alone, without brain or nerves, exercise the vital functions; these likewise may in animals depend on the irritability of the muscular fibre, while sensation, thought, and voluntary motion, result undoubtedly from the presence of a brain.

The womb, in the time of pregnancy, increases in substance and size probably fifty times beyond what it naturally is, and this increase is made up of living animal matter, which is capable of action within itself. I think we may suppose its action more than double; for the action of every individual part of this viscus, at this period, is much increased, even beyond its increase of size; and yet we find that *the nerves* of this part *are not* in *the smallest degree increased.* This shews that the nerves and brain have very little to do with the actions of a part: while the vessels, whose uses are evident, increase in proportion to the increased size: if the same had taken place with the nerves, we should have reasoned from analogy!

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* Vide Observations on the Medicinal Use of the Factitious Airs, by Dr. Beddoes; also the Letters of Dr. Thornton, Dr. Ewart, Dr. Peart, &c. to the same.

If nerves, either of themselves, or from their connexion with the brain, gave vitality to our solids, how should a solid continue irritable, after a nerve is destroyed, or paralytic? for the part continues to be nourished, although not to the full health of voluntary action; and this nourishment is the *blood*, for deprive it of the blood, and it mortifies.

This opinion is countenanced by the experiments of Baron de Haller; some of which are recorded in one of the early volumes of the Philosophical Transactions, for it appears that a *paralysis* of the posterior extremities of animals was induced by tying their aorta.

The learned Dr. Monro, who was not much inclined to give up the pre-eminence of the brain and nervous system to the vascular, after many experiments was obliged to conclude, " *that concomitant arteries, somehow or other, tune the nerves, so as to fit them to convey impressions.*"

In order to decide, says the ingenious Dr. Fowler, whether a greater detriment to that condition of a limb, upon which contraction depends, is induced by interrupting its circulation, or by intercepting its communication with the brain, I resolved upon trying the powers of the nervous electricity as discovered by Galvani.

Having tied the crural artery on one side, and divided the sciatic nerve on the other, on three full grown frogs, I cut off their heads with a pair of scissars, to preserve the circulation of the blood as entire as possible, and at the same time to prevent the continuance of pain, which might exhaust the power of the body, and defeat the experiment.

When these frogs were laid upon a surface of zinc, and excited by means of a rod of silver, the contractions were found extremely feeble in the legs whose artery had been tied, and ceased altogether in about twenty-two hours after their death. But in the legs, whose nerve had been divided, they appeared very vigorous, and continued excitable upwards of two days after they had ceased to be so in the other.

Having thus found, that a diminution of the circulation of a part, was accompanied with a proportionable diminution of the respective powers of nerves and muscles in that part, I next proceeded to examine if an increased circulation would be attended with a proportionable increase of these powers; and that this is actually the case, the facts that I am about to relate will prove.

I have before shewn, that if a living and entire frog be set upon a plate of zinc, contractions can very seldom be produced in any part of its body by passing a rod of silver over it, so that the silver, the frog, and the zinc, may be all in contact with each other. But I have found, in upwards of twenty experinents, that when inflammation had been excited in one of the hind legs of a frog, by irritating it with a brush, contractions uniformly took place in that leg when the metals were applied to it, although none had been produced in it before it was inflamed, nor could it still be produced in the other leg which remained in its natural state.

Having previously, continues Dr. Fowler, excited inflammation, by means of a brush, in the foot and leg of a healthy and large frog, I cut off its head. The contractions excited by the different metals in the inflamed leg were in vigorous and instantaneous jerks; those in the sound leg more languid, and difficultly excited. Spontaneous motions continued at this time nearly the same in both. Even till the end of the second day, after the frog's head had been taken off, the contractions excited in the inflamed leg continued uniformly, and beyond all comparison more vigorous than what I could by any means excite in the sound leg. It then became very stiff.

Dr. Fowler, from these experiments, has judiciously concluded, that the *sanguiferous system* contributes more immediately than the *nervous* to the support of *that condition* of muscles and of nerves, on which *depend all the phœnomena of contraction in the animal fibre.*

This subject, it must be confessed, is after all exceedingly abstruse, and the ideas of the best physiologists are not so clear and distinct, so complete and comprehensive, as we would wish: but, as Dr. Beddoes has judiciously observed,

" *We should set a proper value on our present knowledge,*
" *although it be imperfect, and restrain those rude hands,*
" *that are ever ready to pluck up the tender plants of*
" *science, because they do not bear ripe fruit at a season,*
" *when they can only be putting forth blossoms.*"

SECTION XVIII.

ON TRANSFUSION OF BLOOD.

The first hint of TRANSFUSION was given at Oxford, anno 1658, by Dr. Christopher Wren, Savilian Professor of Astronomy there, who proposed, to the honourable Mr. Boyle, a method of TRANSFUSING LIQUOR into the veins of living animals.

In 1666 his hint was farther improved, at the same constant source of ingenuity and learning, by Dr. Richard Lower, who invented the method of TRANSFUSING BLOOD out of one animal into another.

He was followed by several ingenious men at London, and particularly by Dr. Edmund King, who rendered Lower's method of transfusion still more easy and commodious. And as it was intended by the *Royal Society* that those trials should be prosecuted to the utmost variety which the subject would bear, by exchanging the blood of old and young, sick and healthy, fierce and timid animals; various experiments were accordingly made with surprising effects upon lambs, sheep, dogs, calves, and horses, &c.

From England this invention passed into France and Italy, where, after old and decrepit animals had the agility of their limbs restored by the transfusion of young and healthy blood into their veins, and other wonderful things had been achieved, J. Denis, Doctor of Physic, at Paris, with the assistance of Mons. Emerez, ventured to perform the operation on men in that city; and J. G. Riva, a surgeon of great reputation, made the same experiments at Rome.

After some trials, Mons. Denis published an account of a young man, that was cured of an uncommon *lethargy*, by transfusing the arterial blood of a lamb into his veins: and another account of the cure of *madness* performed on a man 34 years old, by transfusing the arterial blood of a calf into his veins, in the presence of several persons of quality and learning.

This daring enterprise having succeeded so well at the first setting out in France, it was also practised in England from the arteries of a sheep, into the veins of Arthur Coga, Nov. 23, 1667, at Arundel-House, before a splended company, by Dr. Edmund King, and Dr. Richard Lower.

And Coga published, under his own hand, an account of the *great benefit* which he received from the operation.

The illustrious Haller observes, in his Physiology, that by transfusion of blood, the whole machine of the animal is thereby endowed with a remarkable degree of *vivacity*.

Unfortunately this operation was performed on Baron Bond, the son of the first minister of state in Sweden, who had an inflammation of the bowels, and was given over by his physicians, and soon after on a person in a *consumption*; which attempts turning out unsuccessful, the *practice* being *yet* in *its infancy*, and *unsupported* by *sufficient documents*, it fell into *discredit*, and was *prohibited* by the KING'S AUTHORITY in *France*, and by the POPE'S MANDATE at *Rome*.

Thus was defeated a noble essay, begun with prudence in England, but imprudently pursued in France and Sweden, which had the first trials on the human species been conducted with care and caution, might in time, says Dr. Mackenzie, have produced most useful and surprising effects.

The introduction of the *vital air* into the practice of physic, has thrown great light upon this intricate question, and as, in TRANSFUSION, *venal* blood was removed while *oxygenated*, or *arterial* blood was supplied to the veins, the lungs the while imbibing the *vital air*, the constitution was made to *superabound* with *oxygen*; hence arose, as Dr. Thornton observes in a letter to Dr. Beddoes, all the surprising phenomena of TRANSFUSION: but in the present instance, it acts also by *distention*, and the utmost care must be taken to adjust the right quantity of blood, which must be done by carefully noting the alteration of the pulse.

When this experiment was made some years back at Cambridge, by professor Harwood, the blood of a *sheep* was transfused into the veins of a *pointer*, who was previously bled; and more *arterial blood* being admitted than was *proper*, the animal sensible of *plethora*, immediately set about eating *grass*. An old bed-maker who happened to be present, cried out, "Lord, Maister, your dog is already turning into a *sheep!*" In other trials, the animal, after the operation, has wagged his tail, forgiven his master, and seemed, if any thing, more lively than usual.

SECTION XIX.

HOW THE BODY IS AFFECTED BY LIGHT.

Light, like air and water, is known to be not a simple, but a *compound* body. The all-penetrating genius of Sir Isaac Newton has demonstrated, by undeniable experiments, that *a single ray of light*, which former philosophers imagined so infinitely fine, is in reality a collection of *seven parts*, which are perfectly distinct, and composed of as many different colours, and subject to different reflections and refractions.

Some modern philosophers have considered *heat* and *light* as one and the same substance. Although, it must be confessed, they are frequently found existing together, yet, on the other hand, must it be allowed, that there is often *much dazzling splendour* where there is *little* or *no heat*. The Honourable Mr. Boyle draws a minute comparison between the light of combustible bodies, and that of shining wood, &c. Among other things he observes, that extreme cold *extinguished* the light of shining wood, as appeared when a piece of it was put into a glass tube, and held in a freezing mixture. He also found that rotten wood did not *waste* itself by shining, and upon the application of a thermometer he could not discover the smallest degree of *heat.*

That these are distinct substances, may be also proved from their distinct operations on the *living fibre.*

The muscular fibres of the retina are excited into instantaneous action by the smallest variation in *light:* but are insensible to the greatest changes in the circumambient *heat.* Most of the discous flowers, obedient to the impulse of *light,* follow the sun in his course. They attend him in his evening retreat, and meet his rising lustre in the morning. If a plant be shut up in a dark room, and a small hole be made in the shutter, through which the *light* may penetrate, you would see the different plants confined there, turn towards that hole, and even alter their shape to creep through it, so that though these were *straight* before, they would in a short time become *crooked,* to obtain the full enjoyment of *light.* Thus if a GERANIUM be placed in any window for a certain time, the interior surface of every leaf would be turned to meet the *light*; and if you remove it to an opposite window, you would soon see a sad contortion and confusion among the leaves, until they had obtained a right position with regard to *light.* To prove that it is not *heat,* but *light,* which plants covet, if this GERANIUM be placed near a fire, which gives a stronger heat than the sun, you would soon observe it turn away its leaves and flowers from the *fire* to the *sun.*

To illustrate this curious circumstance, Dr. Hill placed a plant of *abrus* in a room, where it had moderate daylight, without the sun shining upon it. The lobes of the leaves were then fallen perpendicularly from the middle rib, and closed together by their under sides. Thus they continued all night. *Half an hour after* day-break, they began to separate, and *a quarter of an hour after* sun-rise, were perfectly expanded. *Long before* sun-set they began to droop again, and towards evening were closed as at first.

Next day the plant was placed where there was *less* light. The lobes were raised in the morning, but *not so much*: and they drooped *earlier* at evening.

The third day it was set in a south window, open to the *full sun.—Early* in the morning the leaves had attained their horizontal situation: by *nine* o'clock they were raised above it, and continued so till *late* in the evening; then they fell to the horizontal situation, and thence gradually to the usual state of rest.

These experiments prove that the whole change is occasioned by *light* only. To put this beyond dispute, in the evening of the sixth day, the plant was set in a book-case, on which the morning sun shone, the doors standing open. The day was bright. The lobes, which had closed in the evening, began to open *early* in the morning, and by *nine* o'clock they were raised in the usual manner. I then, says he, *shut* the doors of the book-case: on opening them an hour after, *the lobes were all closed* as at midnight. On opening the door they expanded again, and in twenty minutes they were fully expanded. This has since been many times repeated, and always with the same success. We can therefore, by admitting or excluding the light, make the plant put on all its changes. Hence we are certain, that what is called *the sleep of plants,* is caused by the absence of *light* alone, and that their various intermediate states are owing to its different degrees.

Some experiments on plants give us reason to believe, that *light* combines with certain parts of vegetables, and that the green of their leaves, and the various colours of their flowers, is chiefly owing to this combination. This much is certain, that plants which grow in darkness are perfectly white, languid, and unhealthy; and that to make them recover vigour, and to acquire their natural colour, the direct influence of *light* is absolutely necessary.

It would be difficult, in the present state of chemical knowledge, to shew the combination of light with *our* bodies. But it cannot but be allowed, that *light* is a stimulus, awakening us to muscular action, and opening an inlet to the stimulus of the various passions.

A thick and impenetrable cloud of *darkness* on a sudden enveloped the Grecian army, and *suspended* the battle.—AJAX, perplexed what course to take, prays thus,

> Accept a warrior's pray'r, eternal Jove;
> This cloud of darkness from the Greeks remove;
> Give us but *light*, and let us see our foes,
> We'll bravely fall, tho' *Jove himself* oppose.

The sentiments of Ajax are here pathetically expressed: it is Ajax himself. He begs not for life: a request like that would be beneath a hero. But because in *that darkness* he could display his valour in no illustrious exploit, and his great heart was unable to brook a sluggish inactivity in the field of action, he only prays for *light*, not doubting to crown his fall with some notable performance, though *Jove himself* should oppose his efforts.

The boy, who was couched for blindness by Mr. Cheselden, had no great expectation of pleasure from a *new sense*; he was only excited by the hopes of being able to read and write; he said, for instance, that he could have no greater pleasure in walking in the garden with his sight, than he had without it, for he walked there at his ease, and was acquainted with every turn. He remarked also, with great justice, that his former blindness gave him one advantage over the rest of mankind, which was that of being able to walk in the night, with confidence and security. But, when he began to make use of this new sense, he seemed transported beyond measure. The brightness of the day, the azure vault of heaven, the verdure of the earth, the crystal of the waters, all employed him at once, and animated and filled him with inexpressible delight. He turned his eyes towards the sun. Its splendour dazzled and overpowered him: he shut them once more; and, to his great concern, he supposed that, during this short interval of *darkness*, he was returning to nothing. New ideas now began to arise; new passions, as yet unperceived, with fears, and pleasures, all took possession of his mind, and prompted his curiosity: and every sense was gratified in all its variety.

I had not, perhaps, been thus diffuse on the article of *light*, unless I had observed, that all animals, when afflicted with illness, fly instinctively to some *silent* and *dark* retreat, where, unaided by art, they quickly recover; and that man, left to the guidance of reason only, often falls short in this respect of the brute creation, and frequently his powers, already weakened by disease, get still the more *exhausted* by an imprudent admission of *company* and *light*. Every one, who has experienced a nervous fever, says the benevolent Mr. Townsend, must have felt the distress that is occasioned by both *these stimuli* at the first onset of this disease.

Let us now view Stern's account of a prisoner. "I beheld his body half wasted away with long expectation and confinement, and felt what kind of sickness of the heart it was which arises from hope deferred.—Upon looking nearer, I saw him *pale* and *wan*:—in thirty years the western breeze had not once warmed his blood—he had seen no sun, no moon, in all that time—nor had the voice of friend or kinsman breathed through his lattice:—his children—but here my heart began to bleed—and I am forced to go on with another part of the portrait. He was sitting upon the ground upon a little straw, in the furthest corner of his dungeon, which was alternately his chair and bed; a little calendar of small sticks were laid at the head, notched all over with the dismal days and nights he had passed there—he had one of these little sticks in his hand, and with a rusty nail he was etching another day of misery to add to the heap. As I darkened the little *light* he had, he lifted up a hopeless eye towards the door, then cast it down—shook his head, and went on with his work of affliction. I heard the chains upon his legs, as he turned his body to lay his little stick upon the bundle.—He gave a deep sigh ——I saw the iron enter into his soul — I burst into tears——"

How cadaverous do servants now appear from Pitt's cruel tax on window lights, and VANSITTART's additional tax on glass.

It is hoped some patriot, or friend of the human race, will cause to be exempted from the duties on windows, all schools, garrets, and work-shops; for our rulers must be monsters indeed, who would inflict unnecessary torments, and create the dwellings of servants and children to resemble the *Hole* at Calcutta.

GENERAL LAWS RESPECTING HEAT.

SECTION XX.

ALL BODIES ARE EXPANDED BY HEAT.

1*st. State of Expansion.*

As comparisons with sensible objects are of great use in assisting us to form distinct notions of abstract ideas, we shall endeavour to illustrate this position, by instancing the phænomena which takes place between water and bodies which are penetrated by it. If we put a loaf of bread into water, this fluid will gradually insinuate itself into its pores, and the bread is soon considerably augmented both in weight and magnitude.—Or if we put a piece of wood into water, it will swell by admitting the water into its substance.—Or if a dry sponge be dipped in water, the sponge swells, its particles are separated from each other. and all its intervals are filled up by the water. The same circumstance undoubtedly takes place with regard to bodies which are immersed in free *Caloric* *. Thus if you take an iron tube, which is filled up exactly by a rod, and heat this rod, it will be found too large for the tube, and will not enter it ; and if you put it by the side of the tube, you will find it also longer than the tube, which when cold it appeared so exactly to fit. Its dimensions are therefore *increased* both in diameter and length. It is so with the rings on the finger. The ring which in health appeared exactly to fit, will drop off in the cold fit of an ague, and will be found on the contrary immoveable during the hot fit. It is upon this principle, that vessels and the wheels of carriages are bound with hoops heated red hot, and applied in this their expanded state, after which they pour cold water upon them, when the iron contracts with such force as to make a deep impression on the wood, and in this way the vessels are bound much faster than they would be by any other means. It is also upon this principle that our *thermometers* are constructed.

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* Distinguished thus from latent or combined heat.

The first invention of this curious and useful instrument is somewhat obscure: but previous to the time of *Sanctorius* it does not appear that the expansive power of heat was much observed. *Sanctorius*'s thermometer was a hollow glass ball, with a long cylindrical tube attached to it, with a small opening at the top, and therefore containing a quantity of air, and in order to observe the variation of the bulk, or elasticity which the air in the ball and tube underwent from the application of heat, he first expelled a small quantity of air out of the vessel by applying heat to it. In consequence of which the air expands, and a small quantity of it comes out. He then puts the extremity of the tube immediately into a coloured liquor, and allows the vessel to become cool again; the consequence is, that the air loses the increase of its elasticity, and the internal air presses up a quantity of the fluid into the tube to fill up the room of the air that had been expelled by the heat, and having thus set up his thermometer, he then applied to the tube a scale of equal parts or degrees, which divides the cavity of the tube into a number of small and equal parts; and as the tube is cylindrical, we can see by these divisions, how the bulk of the air is increased at one time, and diminished at another.—This kind of thermometer was used for a considerable time, when at last it was objected to by the Honourable

Mr. Boyle, that it could not be employed to ascertain the temperature of fluids, and owing to the changes which are known to take place in the weight of the atmosphere, it was fallacious even in those cases in which it could be employed; he therefore attempted to construct a thermometer on some other substance than air, and *spirit of wine* was first thought on, upon account of its being easily tinged, and the considerable change of bulk that it undergoes; and it was very easy to contrive the manner of confining the spirit of wine, or any other fluid, so as to observe distinctly the smallest variation of its bulk by putting it into a ball and tube, whereby a quantity rises in a small and slender thread, which can be easily measured, and divided into a number of small parts, the extremity of the tube being sealed hermetically, so that the pressure of the atmosphere could not affect it, nor could it suffer any loss from exhalation; thus the first useful thermometer was contrived by the Honourable Mr. Boyle. These thermometers were used for twenty or thirty years, till Dr. Halley and Sir Isaac Newton preferred *mercury*.

The *pulse glass*, as it is improperly called, depends also upon this principle. It is a bulb with a long neck to it. As the heat of the hand, following its natural tendency, immediately passes into the colder spirit of wine, in proportion as it enters it increases its bulk, and makes it gradually rise higher into the neck of the vessel, till it has acquired its utmost limit, when it appears to bubble; and to shew that it depends upon heat merely, it will do the same if immersed in hot water; and then if it be removed it will again diminish in bulk, and return to its former place.

Before I quit the subject of *expansion*, it may not be improper to notice, that a knowledge of this law enables us to understand the effect produced upon bodies that are remarkably brittle. Chemists know this but too well, and in private families glasses are repeatedly broken by pouring into them warm water, and even the backs of grates are soon cracked if cold water be thrown upon them after they are quickly heated. In these cases the particles are torn from the colder parts by the expansive power of heat.

2d. *State of Expansion, or that of Fluidity.*

The first expansion carried a little further produces the state of *fluidity*. That this depends upon *absorbed heat* merely, is proved by the following experiment. If you take a quantity of ice, and put in into a bason, and carry it into a room in which the thermometer is at 50 degrees, from the increased temperature, owing to a fire in the chamber, and leave this ice for some time in the room, part of it will be melted. Apply then a thermometer, and it will point to 32 degrees. The same in five minutes, though evidently more heat has entered the mixture, and so continually until every particle of ice, or snow, has been melted. This can only be accounted for by supposing that the free caloric, or heat, has entered into combination with the water, and remains, as chemists are wont to call it, in a *latent* state. That is, the capacity of water for heat is greater than that of ice.

We may readily form an idea of the word *capacity*, by supposing a vessel filled with marbles, into which a quantity of fine sand is poured, which, insinuating into the intervals between the balls, will fill up every void. The marbles in this comparison are to the sand which surrounds them exactly in the same situation as the particles of bodies are with respect to the caloric, with this difference only, that the marbles are supposed to touch each other, whereas the particles of bodies are not in contact, being retained at a small distance from each other by the intervention of the caloric. If, instead of spherical balls, we substitute solid bodies of a hexahedral, octohedral, or any other regular figure, the capacity of the intervals between them will be lessened, and consequently will no longer contain the same quantity of sand. The same thing takes place with regard to natural bodies, the intervals left between their particles are not of equal capacity, but vary in consequence of the different figures and magnitude of their particles, and the different figures and magnitude of their particles are maintained, according to the existing proportion between their inherent attraction, and the repulsive force exerted upon them by the caloric. In this manner we must understand the following expression, introduced by the English philosophers, who have given the first precise ideas upon this subject, namely, the capacity of bodies for containing the matter of heat.

It is upon this principle also that *frigorific mixtures* are formed. The city of *Petersburgh,* which is contiguous to the sea, is exposed to a very intense degree of cold, and that of the year 1760 being very excessive, the mercury stood even at 40 degrees below that of Farhenheit's scale. This being the case, Professor Brown, of the academy there, had the curiosity to try whether by mixing together ice and strong nitrous acid he could congeal even mercury itself; and the artificial cold this produced was so great, that he actually accomplished his experiment, and the mercury in the bulb was converted into a tough metal, which bore a stroke or two of the hammer; and what was in the bore turned out a very fine flexible thread. Thus if a mixture of sal ammoniac and snow be put over a fire, and we place in the middle of this a bowl with some water in it, whilst the snow and sal ammoniac is melting into a liquid, the water in the bowl will be congealed into a mass of ice. We can have no doubt here, but that heat enters into bodies as they become *fluid*, seeing it torn in so surprising a manner from water during the melting of the snow. We see then, that in the change of the ice from the *solid* to the *fluid form*, it *absorbed* a quantity of *heat*, even so much as to render mercury similar in its properties to all the other metallic bodies.

3d. *State of Expansion, or the Aeriform State.*

If you put a cup of æther in a bason of water, and place them in the exhausted receiver of an air-pump, the æther will assume an aeriform state, and the water in the bason will be frozen. In this experiment we see, that in the ordinary temperature of the earth, æther would always exist in an aeriform state, but for the pressure of the atmosphere, and that the passing of the æther from the liquid to the aeriform state is accompanied with a considerable diminution of heat; because during the evaporation a part of the caloric, which was before either free or latent in the surrounding bodies, combines with the æther, causing it to assume the aeriform state.

The effect of the pressure of the atmosphere in the conversion of bodies into these different states was first noticed by the Honourable Mr. Boyle. He found, when making experiments with the air-pump, that water boiled at 90 degrees when the pressure of the atmosphere was taken off, and that therefore both the freezing and boiling points upon thermometers were in some measure defective, being dependant upon the height of the barometer; for when the pressure was greatest the water bore more heat, and vice versa.

In consequence of this discovery Papin formed his *digester*. In this instrument bones may be dissolved, and the water may be made to acquire so great a degree of heat, that an iron wire will melt in it. For a description of this instrument see Ferguson's work.

Before we quit this subject, let us for a moment consider the cause of the *elasticity* of *air*. It is by no means difficult to perceive that this elasticity depends upon that of *caloric*, which seems to be the most eminently elastic body in nature. Nothing is more readily conceived, than that one body should become elastic by entering into combination with another body possessed of that quality.—Elasticity is nothing more than that quality of the particles of bodies by which they recede from each other when forced together. We shall be satisfied of this, when we consider that air is susceptible of undergoing great compression, which supposes that its particles were previously very distant from each other; for the power of approaching together certainly supposes a previous distance, at least equal to the degree of approach.

The acquisition of this property exhibits some of the most curious phænomena we are acquainted with. As children we have been often delighted with *candle-crackers*, but we should now contemplate them as men. They are hollow pieces of glass formed upon the extremity of a tube. This tube is made to contain a drop or two of water, and it is then hermetically sealed. When this is put near the flame of a candle, the water soon acquires the form of steam, the elasticity of which is gradually increased, until it bursts the glass with an exceeding loud crack, and with such violence, that usually the wick of the candle is beat down upon the tallow as if it had received the blow of a hammer.

The distillation of substances depends wholly upon this principle. Steam or vapour is produced by the elastic power of heat. This we have before shewn to vary with the pressure of the atmosphere. Accordingly it is found, that when the air is light (indicated by the barometer being low) the fluid will boil sooner. When the barometer stands at 30 inches, water boils at the temperature of 212 degrees. If it stand so low as 28 inches, water will boil at 208. Hence in distillation we should diminish the pressure of the atmosphere. It is undoubtedly of great advantage to be able by the seclusion of air to work with smaller fires, and this would secure us also in a great measure from those fatal accidents which are often attended with the most terrible effects. Mons. Lavoisier was employed with his chemical friends on this important subject, when the Goth * of the eighteenth century, and his colleagues in iniquity, deprived the world of this great philosopher. The flimsy pretext was that he occupied the place of farmer-general, a receiver of taxes under the former government, but the real motive which produced this execrable action was the justly acquired riches which he was known to possess. Thus was cut off the Newton of the present age in the midst of his useful labours; his house, filled with the most expensive chemical apparatus, free for his numerous visitants, was despoiled; and the honourable rendezvous of men of letters was converted into a den of political thieves. When shall we find again combined equal spirit, industry, and great abilities, which an ample fortune enabled him to employ in their fullest extent!—A great northern genius, when he had occasion to mention this circumstance, overcome by generous feeling, was unable to proceed, and was obliged to decline continuing the lecture. A century may not be able to repair the loss. It is however hoped, for the advancement of science, that the subject will not be entirely dropt. The laws which regulate the formation of elastic vapour, and the phænomena they exhibit, give us that link which closely connects chemistry

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* ROBERSPIERRE.

with mechanical philosophy. Here we see chemical agents and mechanical forces set in immediate opposition to each other, and the one made the indication and measure of the other.

The *steam engine*, is the name of a machine which derives its moving power from the elasticity of the steam of boiling water. It is the most valuable present which the arts of life have ever received from the philosopher. The mariner's compass, the telescope, and other most useful discoveries, were the result of chance, and we do not know to whom we are indebted for them; but the steam-engine was, in the very beginning, the result of reflection, and the production of a very ingenious mind; and every improvement it has received, and every alteration in its construction and principles, were also the results of philosophical study. This invention was made in the reign of Charles II. by the Marquis of Worcester, which he published with ninety-nine other contrivances of his own, which he extols, as of the highest importance to the public. It does not, however, appear that the noble inventor could ever interest the public by these accounts. He was branded as a projector, and the many failures which persons of this turn of mind daily experience, probably prejudiced people against him, and prevented all attention to his projects. The scheme however was revived in the year 1696 by Captain Savary, but it owes its present improved state to the philanthropic Mr. Watt, a person of a truly philosophical mind, eminently conversant in all branches of natural knowledge, and the pupil and intimate friend of Dr. Black, whose illustrious name will be often mentioned in this work, having of late turned his attention much towards the improvement of medicine by the formation and introduction of new aerial remedies.

Without entering more diffusely into examples of the consequences of the change of capacity in bodies when they are altered in their form, it may be observed, and repeated once more, that as the powers of *gravity* and *projection*, in continual opposition to each other, produce all the beautiful effects in the great system of the universe; so, among the actions of the minute parts of bodies, the *cohesive attraction*, and the *repulsion* of *heat*, are in continual opposition to each other, and are concerned in almost every process by which changes are produced in the peculiar properties, or chemical combination, of bodies.

SECTION XXI.

DR. THORNTON'S DISCOVERY OF ANIMAL HEAT AS DEPENDANT UPON THE VITAL AIR IN THE ATMOSPHERE.

It was shewn in the first volume, that when the heart did not receive blood impregnated with *oxygen air* it ceased to beat; besides *the circulation of the blood*, we are indebted also for our *vital heat, to the oxygen air contained within the blood.*

The ingenious Dr. Crawford appears to have been the first who attempted to ascertain by direct experiments the cause of ANIMAL HEAT as dependant upon the air. In an elaborate work he maintains, that the blood, which is returned to the lungs, is highly charged with *phlogiston*,—that the air having a greater affinity for *phlogiston* than the blood, attracts to itself *that principle*, and having in consequence a less *capacity* for heat than before, it parts with a portion of its heat,—and as the *capacity* of the blood for heat is at the same time increased by the separation of the *phlogiston*, the *heat*, detached from the air, is fixed in a quiescent or latent state in the blood :—and that the blood in the course of the circulations absorbing *phlogiston*, and thereby having its *capacity* for *heat* diminished, part of it (in proportion to the quantity of *phlogiston* absorbed) breaks out in the form of sensible or moving heat, and hence the cause of ANIMAL HEAT.

It required a strong philosophic conviction in Dr. Thornton to depart from a proposition at that time so generally received. But having made many experiments, when enquiring into this subject, he was confident, that the OXYGEN AIR which WAS ABSORBED BY THE BLOOD (as is proved in Sect. VI.), was the true source of ANIMAL HEAT. Struck with the important discovery, he proposed it as the subject of his *thesis* at Cambridge. The professor of physic at first refused it, as being an opinion perfectly *novel*. He, however, at length very politely consented to his disputation on this question, and Dr. Thornton maintained at Cambridge, in the year 1792, previous to receiving his degree in physic in that university, in opposition to the opinion of Dr. Crawford, "that the "*venal* blood in the lungs absorbs from the air not *fire*, but "*oxygen*, in combination with *the matter of heat* (OXYGEN "AIR), and that in the circuit of the blood through the "body, the *oxygen*, meeting with some superior attraction, "is divorced from its *caloric**, which becoming disengaged "*(just as an acid discovers its sensible properties, its* "*alkaline basis being withdrawn from it)*, so did it assume "its well known *active* character; and as *uncombined* "*fire* ever tends to form an equilibrium, or equal tempe-"rature with the substances around, by pervading the "body, it became the source of VITAL OR ANIMAL HEAT."

Animal heat, therefore, appears to be a *gentle combus-*

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* (The matter of heat.)

tion :—and *an animal* in many respects may be compared to a *burning lamp*; the HEAT produced in both cases arising from the *same cause.*

If AN ANIMAL be placed in *an exhausted receiver* of an air-pump it quickly expires; in similar circumstances A BURNING LAMP goes out. If AN ANIMAL be not supplied with *fresh air* it dies, and its *heat* is extinguished; so it is with the LAMP. The air breathed by ANIMALS is *diminished in quantity*; so it is by the burning of THE LAMP. A *certain quantity* of air supports AN ANIMAL for a *certain time*, but no longer; so it will keep up the FLAME OF THE LAMP, for a *certain* time only. The air in which a LAMP has burnt out *destroys* ANIMAL *life*; so the air that THE ANIMAL hath breathed, *puts out* THE LAMP. Fixed, azotic, and inflammable airs, *destroy* ANIMALS; so likewise do they *extinguish* THE LAMP.

A LIVING ANIMAL and a BURNING LAMP, therefore, exactly agree in requiring the *same kind of air* to support them, and in producing *the same effects* upon the air, to which they are exposed.

But they do not resemble each other only in *producing* HEAT, *and requiring the same kind* of AIR: for if AN ANIMAL hath not *fresh supplies* of FOOD, as well as AIR, after a *certain time* it dies, and becomes cold; just in the same manner as THE LAMP dies out, if not *duly supplied* with OIL.

Since then *that part* of the air destroyed by RESPIRATION is the *same* as *that* destroyed by COMBUSTION; and since the *ultimate effect* is the *same* in both operations, that is, THE PRODUCTION OF HEAT, is it not reasonable to think, that the FOOD affords to the ANIMAL *principles alike attractive of* OXYGEN, *and disengaging* HEAT, as the OIL affords to THE LAMP? For since *the effects* are the same, *the cause* must be so too. OIL, therefore, *affords* *the principle attractive of* OXYGEN TO THE LAMP: and, consequently, THE FOOD of animals *supports the generation of heat*, by *supplying to the animal body those principles which are attractive of* OXYGEN, *the base of vital air.*

The *chemical analysis* of such substances as are to support animal life confirms this opinion; for no substance affords proper nourishment, which contains not principles that readily combine with OXYGEN; and the instantaneous support, and refreshment, perceived by those, who are much exhausted, upon taking into the stomach certain inflammable substances, as diluted spirits, &c. depend upon the same principle. *Very different matters*, therefore, will support ANIMAL LIFE, if they contain principles, separable by the animal process, that have an affinity with *oxygen.*

To prove that *animal heat* arises from the *decomposition* of VITAL AIR by those substances which attract *oxygen*, we have the following very striking fact.

Dr. Beddoes, the justly celebrated professor of chemistry at Oxford, respired at times for seven weeks air of a much higher than the ordinary standard, and commonly such as contained almost equal parts of oxygen and azotic airs. He relates, in his letter to Dr. Darwin, "that he felt that "agreeable *glow*, and lightness of the chest, which has "been described by Dr. Priestley and others. In no long "time," he says, "I observed in myself a remarkable "power of sustaining *cold.* Except one or two evenings "I never once experienced the sensation of *chilliness*, "though cold easterly winds prevailed, during great "part of the time I inspired the *super-oxygenated air.* I "was not only able," he adds, "to reduce my bed-clothes "to a single blanket and coverlid, but slept without inconvenience in a large bed-chamber, looking to the north-

" east, with the window open all night, and with the door " and windows of an adjacent sitting room also open.— " My appetite was keen, and I eat *one third* or *one fourth* " *more than before*, without feeling the stomach loaded."

Animal heat, therefore, proceeds from the chemical union of certain parts of our food and oxygen, modified, and combined, by the proper exercise of the natural animal functions, disengaging caloric.

When we come to treat on digestion, it will be shewn how the *gastric juice* has a solvent power over *certain substances.* Our aliment is therefore broken down in the stomach into its constituent principles, and these comminuted parts then enter and pass along the capillaries of the intestines, which are incapable of admitting any substance, unless in an highly attenuated or *aerial* form.

The anatomical lecturer at Pisa, in the year 1597, happening to hold a lighted candle near the subject he was dissecting, on a sudden the vapours that issued from the stomach and intestines were set on fire. In the same year Dr. Ruisch was dissecting a woman, and had no sooner opened the stomach, than there issued out a yellow greenish flame, supposed to have arisen from the vapours, which were kindled by a student's holding a lighted candle near him. Dr. Vulpare, the anatomical professor at Bologna, affirms that any one may see, issuing from the stomach of an animal, a vapour that *burns like spirits of wine*, if the upper and lower orifices are bound fast with a tight thread. The stomach thus tied up, must be cut immediately under the upper ligature, the contents of the stomach being first pressed with both hands, so as to pass to one side. A candle being held about half an inch from the aperture, a flame will be observed immediately to issue from the stomach. Bartholine relates the case of a person, who having drank much brandy for a wager, died, after an eruption of a flame of fire had first issued from his mouth. *The inflammable woman of Coventry*, as described by Mr. Wilmer, appears also to have reduced herself by dram-drinking to such a state as to be capable of being set on fire, and burn like any very combustible matter; *so eager*, says the learned Dr. Beddoes, *were the principles of which she was composed to combine with oxygen.* In like manner the Countess *Cornelia Bandi*, near Cesena in Romagna, in 1731, in the sixty-second year of her age, was found in the middle of her bed-chamber reduced to ashes. These ashes were light, and left in the hand a greasy and sticking moisture. The floor was smeared with a gross unpleasant moisture, and the walls and furniture were covered with a moist soot.

An instance of the same kind occurred at Christ-Church in Hampshire, June 26, 1613; one John Hitchell, a carpenter of that parish, a great drunkard, having ended his day's work, came home and went to bed. His wife found him dead before morning at her side. He felt so extremely hot, that it was impossible to touch him. *He lay burning for three days*; nor was there any appearance of flame outwardly, but only a smoke or mist ascending from his carcase till it was consumed.

These curious instances of *quick combustion* carried on in the body, if I may be allowed to continue the expression, are adduced only as exceptions to Dr. Thornton's general rule, " that within the body there is " always carried on a *gentle combustion*, productive of " *the vital flame*."

SECTION XXII.

HOW LIFE DEPENDS UPON A DUE QUANTITY OF ANIMAL HEAT.

In the last Section it was proved, that *vital heat arose from the decomposition of oxygen air in the blood.* In this it will appear, *how life depends on a certain degree of heat in the body.*

In the chick contained within an egg there are no powers capable of generating heat. Therefore until the chick receives heat from the mother, it remains in a torpid and inactive state. The principles of life are then called into action. A gradual extension of the parts commence. During the time of incubation, the living principle every day increases in quantity and power with the perfection of the animal, and the capacity of its organs for performing its functions, and *generating heat,* which last does not happen till the time of its exclusion from the shell: after which, the chick does not depend *entirely* on the mother for the production of that heat, which must always accompany and support the functions of life. When, by respiration, the first action after birth, *oxygen air* is absorbed by the blood, the motion of the heart, the circulation, and other operations, are carried on with greater vigour than formerly, and the food being separated into principles attractive of *oxygen,* the chick is capable, in a great measure, of generating a degree of heat equal to that of the parent. At first the mother, by a wonderful instinct, as if conscious of the tender state of her offspring, and of the impossibility of their being kept sufficiently warm by their own powers, gathers them under her wings to cherish that vital warmth, which she appears to judge them incapable of creating, and *without which* they would necessarily perish. In the same way, if, during incubation, the hen leaves her nest so long as to cool the eggs a few degrees, from that period the powers of life are proportionably diminished, and a stop is put to the growth of the chick; both of which, if the eggs have not been cooled too far, are recoverable on the return of the hen, or of that genial heat they receive from her body. The mother is so solicitous to preserve *this heat*, that she seldom leaves her nest above five or six minutes in the day, to take a slender repast; and when she discovers the motion of the chickens in the eggs, she then sits so close, that even the sight of food, though ever so much pressed by hunger, can scarcely prevail with her to stir from the eggs for three or four days, or until they are completely hatched. But if she abandons her nest altogether, or is killed by accident, then, as the eggs cool, the powers of life gradually decline, till they are at last totally abolished by the death of the chickens.

Though *the functions of life*, in this instance, are soon destroyed or suspended for want of a due quantity of animal heat, yet in some creatures, under these circumstances, the *vital principle* still remains intire. Thus flies, when the cold comes in, appear as if deprived of sense, and in proportion to the degree of cold, the *moving mechanism* is *retarded.* But if the weather be *intensely cold, they then " sleep the sleep of death."* Hence the reason why we see toads burrowing, frogs living under large stones, snails seeking shelter in the hollows of trees, and fishes having recourse to deep waters; the heat of all these places being generally *above* the freezing point, even in our frosts, which are however sometimes so severe, as to kill many whose habitations are not well chosen.

Some years ago I cut out, says Dr. Gardinor, the heart and part of the large vessels of a turtle, with a view to examine the structure of these parts and the circulation of the blood in that animal. Having wiped off the blood and other moisture, the heart was wrapped up in a handkerchief; but engagements in the way of my profession obliged me to postpone my curiosity till about six or seven hours after it was cut out. When I examined it, there appeared not the *least signs* of life. It was much shrivelled and dried. But, by putting it into water, nearly *milk warm*, it plumped up, and some of its parts acquired a tremulous motion. Laying it on the table, and pricking it with a large needle, it palpitated several times. The palpitations were renewed, as often as the needle was pushed into its substance, until it became *cold*, when it seemed to be insensible to every stimulus. But, after *warming* it again in the water, it recovered its *irritability*, and repeated its palpitations on the application of the needle. Though no movement could be excited in it by any stimulus when *cold*, yet it moved several times after being macerated in *warm water*. *This evidently shews the necessity of* HEAT *for maintaining the full powers of the contractile living principle.*

The effects of temperature is, in a most satisfactory manner, illustrated by the learned and ingenious Dr. Robertson, in his history of *America*; when taking a view of the effects of climate on the human body, he says,—" In every part of the earth where man exists, the power of climate operates with *decisive influence* upon his condition and character. In those countries which approach near to the *extremes* of *heat* or *cold*, this influence is so conspicuous as to strike every eye. When we consider man merely as an animal, or as a being endowed with rational powers, which fit him for activity and speculation, we shall find that he has uniformly attained the greatest perfection, of which his nature is capable, in the *temperate regions* of the globe. There his constitution is most vigorous, his organs most acute, and his form most beautiful. There, too, he possesses a superior extent of capacity, greater fertility of imagination, more enterprising courage, and a sensibility of heart, which gives birth to passions not only *ardent* but *persevering*. In this favourite situation he has displayed the utmost effects of his genius, in literature, in policy, in commerce, war, and in all the arts which improve and embellish life."

He accordingly divides the natives of America into *two distinct classes*; the *one* inhabits the *temperate*, the *other* the *torridz ones*, on both sides of *the line*. He says, " that the human species in the *former* appears manifestly more perfect: that the natives are more robust, more intelligent, more active, and more courageous. They possess, in the most eminent degree, that force of mind, and love of independance, which are regarded as the chief virtues of man in his savage state. These natives accordingly, though surrounded for several centuries past by polished and hostile nations, have hitherto maintained, in a great degree, their freedom and independance: but the *other* class, from the debility of their mind and body, their inactivity, want of active courage, and of that independence which characterises those living in the more *temperate climates*, have become so dependent as to be nearly in a state of slavery to those nations, who, for the sake of mines or commerce, have taken possession of their territories."

SECTION XXIII.

HOW NATURE INCREASES OR RIDS HERSELF OF THE ANIMAL HEAT.

In the last Section *the close connexion between life and heat* was shewn; we shall slightly consider here *the method Nature takes to increase or rid herself of this subtile and penetrating fluid.*

1. *Animal Heat usually exceeds the surrounding Air**.

As the heat of the living body generally *exceeds* that of the surrounding atmosphere, it is obvious, so far from any heat being derived from it, on the contrary, the body must *communicate* heat to the external air; and if we consider the great difference subsisting between the temperature of the human body, and that of the atmosphere in our climate, it is clear that a very large portion of heat must be ever *escaping* from the body, and of course there must be *constant generation* of animal heat carried on in the body to balance this consumption.

Every one who has paid attention to the temperature of the atmosphere by means of the thermometer, must have observed how frequently our feelings, respecting heat and cold, *disagree* with the indications of them, as expressed by that instrument; since it often happens, that when experiencing a very considerable degree of cold, we are surprised to find the mercury at a moderate temperature; and this may be observed usually to happen in *windy weather*, or when the air is particularly loaded with *wet particles.*

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* A thermometer being put under the tongue of man in all countries *rises* to 97.

This can be accounted for on no other principle than that of *the constant production of heat within the animal, and of its tendency to pass off by the surface:* for the thermometer very soon acquiring the temperature of the air, becomes at once stationary, varying only with the real changes which take place in the atmosphere; whereas the constant succession of heat, which there is in the living animal, prevents it acquiring the temperature of the air, and it cannot, therefore, like the mercury, descend to its temperature, and then become stationary; and as the sense of cold felt by us, must consequently be owing to the constant *escape* of heat which is thus promoted, the degree of cold felt must obviously be in proportion to the celerity with which the air is enabled to *carry off* the warm atmosphere surrounding us.

The effects produced by *fanning*, when persons are very hot, may be understood from the principles of the foregoing doctrine: when the surface is loaded with heat, and the air, which is in immediate contact with it, has already taken up so much, that it is either unable to carry off any more, or performs this office so slowly, as to be unequal to the removal of the quantity which is constantly arriving at the surface, the driving away such air by the fan, and permitting other colder air to approach, which not being so loaded, is able to carry off the heat more quickly, the skin must in consequence feel cooled.

Moist air is, likewise, a better conductor of heat than when dry, because *water*, though of the same temperature with air, is well known to carry it off more quickly than air will do.

If, therefore, *these two causes unite*, as is the case in *moist* and *windy* weather, we may easily understand why the heat from animals should be carried off more quickly, and the animals should experience a greater sense of cold than when the air is *still* and *dry*, though the thermometer should, in both cases, stand at the same point.

Even in torpid animals the temperature of heat is constantly *higher* than the surrounding medium.

In the *winter*, the atmosphere at forty-four degrees, the heat of the torpid hedge-hog at the diaphragm was found, by Dr. Jenner, to be 48°½.

When the atmosphere was at twenty-six degrees, the heat of a torpid hedge-hog was reduced so low as 30°.

In *summer*, the atmosphere at seventy-eight degrees, the heat of the hedge-hog at the diaphragm was found to be 97°.

The atmosphere being at thirty, that ingenious and most accurate experimental philosopher, Dr. Haighton, the present Lecturer on Physiology at Guy's Hospital, found the animal heat of a torpid bat at 33°; and when the atmosphere was at sixty, he found it so high as 63°; that is, during life the *vital heat* was always found, even in dormant animals, *to exceed the surrounding medium*.

2. *Of the Retention of Animal Heat.*

It may be remarked, that all animals, when the heat is passing off them in an *inconvenient degree*, endeavour to CHECK IT by lessening the surface of their bodies, which is exposed to the surrounding air; thus we see why dogs, cats, &c. when lying on the ground, and not in a warm situation, draw their limbs close to them, and endeavour to acquire such a posture of the whole body, as shall bring all the parts as much into contact as possible; and when in a contrary situation, as exposed to the warm rays of the sun, or near the fire, they stretch out their limbs, and extend their whole surface as much as possible: and we all know, that we ourselves, when naked, or when entering a cold bed, do exactly the same thing; and in bed we continue such a posture until such a quantity of heat has been accumulated, and confined by the bed-clothes, as to remove all sensation of cold, when, like the before-mentioned animals, we stretch forth our limbs, and acquire our accustomed posture.

The universal custom of the inhabitants of all countries in which the temperature of the atmosphere is below the standard of the heat of the human body, making use of apparel, and this being thicker or thinner in proportion to the respective differences of seasons or climates, is founded on the same principle, *to prevent such an escape of heat from the body as would be unpleasant or injurious.*

The same thing may be observed of the natural clothing of different animals; in *warm climates* their coats are short, smooth, and lie close to the skin; but in the *northern regions* their covering consists of a rarer substance, as fur, wool, &c.

It may likewise be observed, that even in the *same animals* a difference, respecting the heat-conducting powers of their covering, takes place under different exposures; that in summer it is less calculated to retain their heat than in *winter*; and when protected by the external cold, by living *within doors*, than when exposed to it when living in the *open air.* The horse may be considered as a very familiar instance of the truth of this remark, for every one knows how long and rough the coats of those are which winter in the *straw-yard*, and how short and smooth are the coats of those which are kept in warm *stables*; and that it is a common practice with such as have the care of horses, to cover them with woollen cloths, to render their coats fine and smooth.

In *birds* this provident care of nature is peculiarly striking; as they pass freely through the air, and are often exposed in the higher regions to a very cold medium, their natural heat would pass off much too quickly, if they were not covered with a substance which conducts heat very slowly, which feathers are well known to do: and in those birds that *live in water*, which withdraws heat much quicker than air, their covering is much more rare and compact than common feathers; the down upon the breast and under the bellies of those birds, which in cold climates live principally in the water, being perhaps the slowest conductors of heat in nature; modern luxury having, on this principle, set a great value on the down of the *eider duck*, and its use in retaining heat, to which it is applied, being well known in fits of the gout; to which cases, on account of its extraordinary lightness, it is particularly well adapted, as the parts affected are usually so exquisitely tender, as to suffer pain from the contact of whatever has weight, or occasions pressure. The slow conducting power of this down being evidently owing to its rare texture, it is obvious, that to retain this quality it should remain perfectly dry, as the plumage, when *wet**, will very soon collapse together, and form a body capable of carrying heat off, perhaps, too quickly. To guard against this circumstance, Nature has kindly furnished *these aquatic birds* with a peculiar kind of OIL, and has given them the power of occasionally opening the receptacle where it is deposited, and of spreading a sufficient quantity of it over their outermost feathers, by which the contact of water is effectually prevented.

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* Mr. HUNTER, having put a *dormouse* in a freezing mixture, could not freeze the whole animal, but only the feet, the hair being so bad a conductor of heat, that the *heat* withdrawn from the animal was not more than its powers were capable of generating. Taught by the failure of this experiment, I took care, says this great physiologist, that the hair should not a second time be an obstruction to our success. Having, therefore, first made the animal *wet all over*, that its heat might be more expeditiously carried off, it was put into a leaden vessel, and the whole placed in the cold mixture as before. The animal soon gave signs of feeling the cold, by *coiling* itself into a round form, and repeatedly attempting to make its escape; and the breath and water evaporating from its body being soon frozen, appeared like a hoar frost on the sides of the vessel, and on its whiskers; but as long as the vigour of life lasted, it seemed to defy the cold. However, from the air being *wet*, and thereby rendered a good conductor, there was a much greater consumption of heat than in the first

Lastly, we may observe, that the *sensible perspiration* is much less in cold than in hot weather, which circumstance in the next paragraph will be more particularly considered.

3. *The Escape of Animal Heat.*

When the air is of that particular temperature which, with the assistance of other operations in the œconomy, is just sufficient to carry off such a quantity of the heat generated in the body, that the remainder shall exactly support the animal body, we say such an air is mild, or it is temperate; because we are not sensible of any troublesome degree of heat or cold. This precise temperature varies in different people, according to the climate, age, and constitution of the individual; but at whatever point of the thermometer this temperature may be, if it rises or falls a few degrees only, we then complain of heat or of cold, and employ various ways of obviating their effects. when we are surrounded with a *warm air*, a *free perspiration* succeeds; and if a further accumulation of heat takes place in the body, a *sweat* is brought on proportioned to the stimulus, from the excess of heat. Nature is now em-

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experiment; which hastened on a diminution of the power of producing it. The animal soon became stiff; and upon being thawed, was found quite dead. HUNTER *on the Animal Economy.*

ployed in COUNTERACTING *the effects of an accumulation of heat* by the refrigerating process of *sweating*, and the consequent expenditure of heat in the formation of vapour. How soon will the mercury and the thermometer cool by the ball being wet with æther, or volatile alkali! The degree of cold that may be produced in this way, has been sufficiently proved by the celebrated Dr. Cullen. Witness the ice found in the morning on linen hung out to dry during the night, when the temperature of the air is even much above the freezing point: the practice of cooling wine in warm countries, by hanging up their bottles in wet cloths to the sun †, to expedite the evaporation; the cooling of the wine going on in proportion to the quickness with which its heat is abstracted by the vapour. I should not have insisted so much on the effects of *evaporation*, says Dr. Gardiner, President of the Royal College of Physicians at Edinburgh, had I not considered it as a material circumstance in examining the effects of hot air on the human body, which sooner or later, according to the degree of heat it possesses, produces, in the manner above-mentioned, a *sweat*, and consequently *evaporation* from every part of the body. Not that the whole of the matter perspired is turned into vapour; it is only such a portion of it as can readily absorb the necessary quantity of heat from the body and external air, which will be in proportion to the degree of heat they possess; the rest running in drops off the body, or it is absorbed by the cloths, and is afterwards evaporated from them.

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† The Arabians have this remarkable method of cooling their wines when conducting caravans over the deserts, which exhibits, in the most forcible manner, the truth of the above account. They dig a hole, and having filled it with straw, they place the bottle of wine they mean to cool into the midst of it, having previously surrounded it with *wet* straw or clay. They then set fire to the straw, and the bottle of wine is brought out (from the evaporation of the wet clay or straw surrounding it) *quite cool.* Vide Philos. Trans. Vol. LXV. p. 252.

The matter of heat, or caloric, finds, moreover, other outlets to escape by, besides the surface of the body; as a considerable quantity must, evidently, pass off from the *lungs* in breathing. Indeed the quantity which is carried off by the air, as also by the lungs, is found, by experience, to be much greater than one would at first imagine, "*for we know that the heat contained in one breath of air, will, if properly managed, raise Fahrenheit's thermometer ten degrees* ‡." And provident Nature seems to take advantage of this circumstance, when an extraordinary quantity of heat is suddenly excited in those animals, which are but little able to carry off a superabundance: thus *dogs*, which do not sweat, and *sheep*, whose clothing is so particularly unfavourable to the carrying off an unusual quantity of heat, always open their mouths very wide, that the whole surface of the fauces may be exposed, and move the tongue remarkably quick, to agitate the air in contact with it.

When heat is accumulated in the system, either by fever, by strong exercise, or by the scorching heat of the sun, Nature constantly cries aloud for ACIDS, and a *cooling diet*; and to those who have turned their mind to chemistry, the reason for this strong desire is obvious. They know that *animal heat* originates in the decomposition of OXYGEN AIR, after it is received into the blood by the lungs; and they observe, that the quantity of air which is decomposed or vitiated, bears direct proportion (as will be explained when mentioning the experience of the celebrated diver Mr. Spalding) to the quantity of combustible matter, whether animal or vegetable, whether sugar, oil, or spirits, received into the stomach. They observe, likewise, that

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‡ Vide Critical Review for January 1782, page 6.

acids taken into the stomach always check, and restrain the generation of heat; or, in other words, that when the system is saturated with OXYGEN only, less OXYGEN AIR (oxygen and *caloric*) is imbibed by the blood in the lungs, and consequently less *heat* will be evolved in the body. It is upon these principles, says the Rev. Mr. Townsend, that the reapers in the south of Spain covet their *guzpacho*, composed of bread, oil, and *vinegar:* the two first articles for nutriment, and the latter to moderate their vital heat. On the same principles, obedient to the voice of nature, during the sultry heats of summer, we equally desire our lettuce, oil, and *vinegar*, and we may remark, that in *warm climates*, and in summer in the *more temperate regions* of the globe, the *acescent* and watery fruits abound, but in the autumn *we* have chiefly those which produce *oil* and *sugar*, while dried *fish*, *meat*, and train *oil*, form the principal support of the hardy inhabitants of the *north*.

SECTION XXIV.

ON CLOTHING.

1. *Of the Clothing of Infants.*

Midwifery was first practised by women. Hence the dressing of children became an art which few could attain unto. Each midwife strove to outdo all others in this pretended knowledge. These attempts were seconded by the vanity of parents, who, too often desirous of making a show of the infant as soon as it was born, were ambitious to have as much *finery* heaped upon it as possible. Thus it came to be thought as necessary for a midwife to excel in bracing and dressing an infant, as for a surgeon to be expert in applying bandages to a broken limb; and the poor child as soon as it came into the world, had as many rollers and wrappers applied to the throat * and body, as if every bone had been fractured in the birth; while these were often so tight, as not only to gall and wound its tender frame, but even to obstruct the motion of the organs necessary for life.

NATURE knows no other use of clothes but to keep the body *warm*. All that is necessary for this purpose, is, when the child is born, to excite the external circulation by rubbing it with brandy and water with the warm hand, and having affixed the *belly-band* made of *fleecy hosiery* †, to wrap it in a loose covering of the same soft material; and then to lay it by the side of the fond mother to partake of *her* vital warmth ‡. Were parents left to the dictates of Nature alone, they would certainly follow this method. If we consider the body of an infant as a bundle of soft pipes, replenished with fluids in continual motion, the danger of *pressure* § will appear in the strongest light. NATURE, in order to make way for the growth of children, has formed their bodies soft and flexible; and lest they should receive any injury from pressure in the womb, has surrounded the fœtus every where with yielding fluids. This shews the care which NATURE takes to prevent all unequal pressure on the bodies of infants, and to defend them against every thing that might in the least cramp or confine their motions.

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* As the *long stay* to hinder the child from bending back the head and breaking its neck!

† More will be said hereafter of this happy discovery. At the same time that it is *warm* and *unirritating*, it is perfectly *elastic*.

‡ Vide Section XXII. *How life depends on a certain degree of heat in the body*.

§ Some allowance ought certainly to be made for the swelling of the muscles during sleep.

Not only the analogy of other animals, but the very feelings of infants, informs us, they ought to be kept easy and free from pressure. They cannot indeed tell us their complaint; but they can shew signs of pain; and this they never fail to do, by crying when pinched by their clothes. No sooner are they freed from their bracings, than they seem pleased and happy; yet, strange infatuation! the moment they hold their peace, they are again committed to their chains. I have known, says the benevolent Dr. Buchan, numerous children seized with *convulsion-fits* soon after the midwife had done swaddling them, who, upon taking off the rollers and bandages, were immediately relieved, and never had that disease recur afterwards.

2. *Of the Clothing of Adults.*

We have before contemplated the benevolent care of PROVIDENCE to the lower order of creatures in providing them with *clothing suited to the climate and the season of the year* *. The horse, the deer, and birds, *double* their covering in the beginning of the cold season, and *shed* it in the spring when a warm garment is no longer serviceable. The beaver removed to the higher latitudes exchanges its fur, and the sheep its wool, for a coarse hair, *to allow of the escape of heat.* The coarse and black shag of the bear, on the contrary, is converted in the arctic regions into the finest and whitest fur to *retain the vital flame.*—In short the softness and density of hair in animals seems always in proportion to the coldness of the country. The Canadian and Russian furs are therefore better than the furs of climates farther removed from the north. It is well known that the fur of the ermine is the most valuable of any hitherto discovered: and it is in winter only that this little animal has it of the proper colour and consistence. NATURE has provided some animals with another resource; when the season becomes too cold for their constitutions, they sleep, or emigrate into warmer climates.

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* When treating, Sect. XXI. *On Animal Heat;* also Sect. XXII. *How Life depends on a certain Degree of Heat in the Body;* and in Sect. XXIII. *On the Method Nature takes to increase or rid herself of this subtle and penetrating Fluid.*

Pliny, one of the most celebrated naturalists of antiquity, pathetically laments, "that whilst NATURE has given "various clothing to the brute creation, and even fenced "plants and trees with bark, against the injuries of the "cold and heat, she should have cast man into this world "naked, unprovided against the inclemency of different "climates and seasons." But instead of agreeing with that philosopher, that NATURE has, in this particular, acted more like a cruel step-mother, than a kind and indulgent parent to man, we cannot sufficiently extol her providence and wisdom. It was no more than consistent with equity to provide the irrational part of her works with clothing suitable to their circumstances; but man, whom she endued with the transcending faculty of *reason*, she hath very wisely left to accommodate himself to the difference of seasons and of climate, and to clothe himself accordingly with the plumes, the fleeces, the skins of animals, and the products of various plants and trees. This would invariably be found to be the case, were not man, alas! servilely imitative, and in the highest degree capricious in the ornaments of his person. Hence it is, that the nations beyond the *Indus*, as well as the *Tartars*, are at great pains to compress their eyes at the corners, and to stretch their ears by heavy weights appended to them, and pulling them frequently with the fingers, so that they may hang down to their shoulders, which *they* consider as the highest mark of beauty. On the same principle, they extirpate the hair from their bodies; and, on the face, they leave only a few tufts here and there. The *Tartars* frequently extirpate the whole hair of the head, except a knot on the crown, which they braid and adorn in different manners. Some, and among others the *Turks*, cut the hair off their heads, and let their beards grow. The *Europeans*, on the contrary, shave their beards, and wear their hair. Every nation seems to have entertained prejudices, at different times, in favour of one part or another of the beard. Kingson assures us, that a considerable part of the religion of the *Tartars* consists in the management of their whiskers; and that they waged a long and bloody war with the *Persians*, declaring them infidels, merely because they would not give their whiskers the *orthodox* cut. Peter the Great had nearly occasioned a revolution in his kingdom, by wishing to have his subjects shaved. In our country we daily see men who encourage the growth of the hair on the cheek, below the ear, to look fierce, while others again wish to have the size of their understanding measured by the size of their heads. The largeness of the doctor's wig[*] arises evidently from the same cause as the smallness of the beau's queue. In *Arabia* and *Greece* large eyes are esteemed beautiful; and in these

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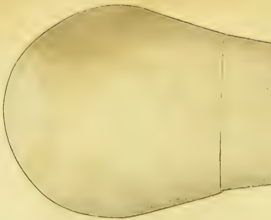
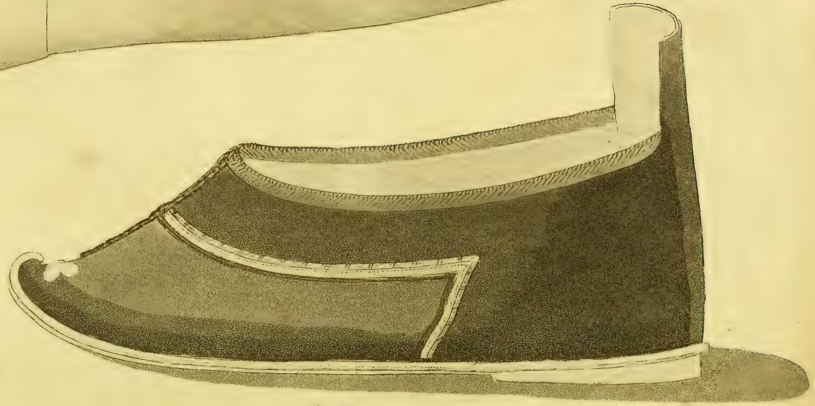
[†] The tye-wig was disused in England through the humour of Dr. Somerville. Some of the faculty having taken offence, that he came not unfrequently to *George's* unarrayed with the sword, and in coloured clothes, and being on that account one day openly insulted by his indignant brethren, he came the next day to the coffee-house, having on the jehu of his coachman, who, on the contrary, had on the doctor's tye.—" *Here, gentlemen,* he said, *is an argument to the purpose, that knowledge* " *does not consist in exteriors. There are none of you, who would trust me* " *to drive you, and the world shall soon see, also, as I pass through the* " *streets of London, that the wig does not constitute the physician.*"—Having made for several days this curious exhibition, the tye-wig was quickly converted into a subject of ridicule, and Dr. Somerville gained the day.



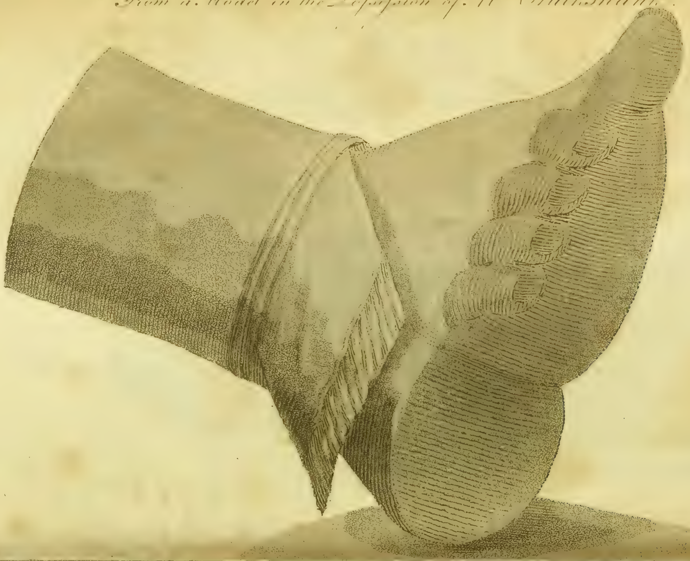
The Sole



A Chinese Shoe.

A Chinese Foot,

From a Model in the Poſseſsion of Mr Cruikshank.



countries they take extraordinary pains to stretch the lids, and extend their aperture. Among some *Indian tribes* in *America* they flatten the forehead in infancy by the application of broad plates of lead, and file to a point all the teeth to imitate the canine. In *Africa* they flatten the nose, to accomplish *their* idea of beauty. The skin in many nations is darkened by art; and all savages esteem certain kinds of deformity to be perfections; and strive to heighten the admiration of their persons, by augmenting the terror of their features. In *China*, the reigning fashion is still more contemptible; to appear *ever idle*, they suffer their finger nails to grow to an enormous length, and *pinch their feet* into the smallest size imaginable. The latter custom has unfortunately reached these kingdoms. Instead of having the size and figure of the shoe adapted to the shape of the foot, the toes must be crampt, and deprived of all separation, which the perspiration of that part seems to demand †, and nine tenths of mankind are troubled with corns, a complaint that is seldom or never occasioned but by narrow and pointed shoes. The ladies, who ever improve on the fashions of the time, to gain a little in height, lengthen out the heel, and constantly walk on *tiptoe*. The consequence of which is, acting contrary to the intentions of NATURE, they never seem to walk well; and as the fibres of the muscles of the calf are not drawn into their due tension, they become subject to frequent and incurable *cramps* which, as disturbing sleep, is again the remote cause of other dreadful disorders.

The shape God has given is too often attempted to be *mended* by dress, and those who know no better, believe that mankind would be frights without its assistance.

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† Dr. Vaughan, of Rochester, recommends stockings to be made with the separation like gloves.

The bones of growing persons are so cartilaginous, that they readily yield to the slightest pressure, and easily assume the shape of the mould in which they are confined. Hence it is that so many girls in proportion to boys are mishapen*. Deformity of body may indeed proceed from weakness or disease; but in general, says Dr. Buchan, it is the effect of improper clothing. The pressure of the abdomen by stays impedes the action of the stomach and bowels, and the motion necessary for respiration, and consequently the just circulation of the blood. Hence a train of dreadful disorders ensue. The pliancy of the body, and the natural grace of the female form, is prevented by this rigid coat of mail. The imprudent zeal of the mother for a fine shape performs another most unkindly office to the child. She frequently becomes either incapacitated for marriage, or dies in child-birth. The madness in favour of stays seems, however, to be somewhat abated; and it is hoped the world will, in time, become wise enough to know, that the human shape does not solely depend upon whalebone and bend-leather.

In *England* we seldom enjoy any continuance of settled weather, except towards the close of summer, and the beginning of autumn, and even then we are frequently balked in our expectations. The sudden changes that take place during three fourths of our year may be regarded as no less prejudicial to the health, than disagreeable to our feelings; and our terrors of *catching cold*, which have frequently appeared ridiculous to foreigners, are really better founded than we ourselves are apt, most of us, to apprehend; *colds* in their *consequences* proving fatal to thousands every year. Though we cannot hope entirely to escape the unpleasant sensations, or altogether to ward off the fatal effects occasioned by this caprice of our climate; yet considering properly *the nature of clothing*, we may avoid much of the danger. If *ladies* are subject to *catch cold* more frequently than men, it is not *alone* their delicacy of constitution, or their being more confined within doors; but the frequent changes they make in the quality or quantity of their garments, and sometimes, however fearful of a partial current of air, because they expose even those parts of the body, that a little before had been warmly covered. If a greater proportion of females fall victims to *consumption*, is it not because, losing sight more than men of its primary purpose, they regulate their dress solely by idle and fantastic ideas of elegance? If happily our regret should recall the age of chivalry,—to break the spell of *fashion* would be an achievement worthy the most gallant of our future knights. Common sense has always failed in the adventure; and our ladies, alas! are still compelled, whenever the enchantress waves her wand, to expose themselves, half undressed, to the fogs and frosts of our island.

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* A Lady in the city, who had no girls, though her family was numerous, but were *mishapen*, consulted the celebrated anatomist Mr. Cline, on the prevention. " *To have no stays—and to let the next girl run about like the boys*," was the excellent advice of this gentleman, which being complied with, neither she nor any of the future children were afterwards *marred* by the ill-placed attention of the ignorant mother. This story Mr. Cline is very careful to deliver in his public lectures at St. Thomas's Hospital.

It is, I believe, says the celebrated Dr. Beddoes, unfortunate for the inhabitants of this country, that we are not subject to such a continued severity of cold, as should oblige us regularly to fortify ourselves by *warm clothing*. By linen worn exclusively, we lose more in health than we gain in comfort; which comfort is, perhaps, after all, merely imaginary; for from the representation of Dr. Thornton, he appears to have supported the remarkable heats of a very hot summer, better than most other persons, by having on, instead of linen next his skin, a *fleecy hosiery waistcoat*[*].

It is a mistaken notion, says Sir Benjamin Thompson, that flannel is too warm a clothing for summer. I have worn it, says he, in the hottest climates, and in all seasons of the year, and never found the least inconvenience from it. Sir Benjamin moreover adds, I shall be happy if what I have said or done respecting *flannel*[†] should induce others to make a trial of what I have so long experienced with the greatest advantage, and which I am confident they will find to contribute greatly to health, and consequently to all the other comforts and enjoyments of life. As being the most effectual method to escape the influence of sudden changes of atmospherical temperature, and because flannel is so much less unpleasant, when moist, than linen. *Fleecy hosiery*, or *flannel*, should be worn during every season in Great Britain ; and those who feel it necessary may add above the linen in winter a cotton under-waistcoat, which he may put off during the warm weather, and resume again in the autumn. The philanthropic Jonas Hanway was a very great advocate for *warm clothing*. Being in a decline, he was ordered by his physicians to the south of France: but some very urgent business calling him to visit Holland, in the moist air of that country he recovered, and remarks that the Dutch are less subject to this dreadful calamity, which he attributes partly to the air*, and partly to their warm method of clothing. He adds, if a number of persons meet in a room, where there is no fire, and they feel cold, no pleasant conversation takes place, and *warm clothing* ought therefore to be used, if for no other reason than for the preservation of *good humour*. Boerhaave's favourate receipt for health was, "to leave off our winter clothing on Midsummer day, and to resume it the day following."

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[*] Vide his Letters as published by Dr. Beddoes, in which he adds, "*and since my first using this under garb, I am not subject to catch cold* "*as formerly from the vicissitudes of the weather.*"

[†] Had Sir Benjamin Thompson known the *fleecy hosiery*, he would most probably have recommended it in preference to *flannel*. It *equally* attracts and imbibes the moisture of the skin : but the former as being *elastic* embraces the body, as being from an animal substance is *warmer* and *lighter* for wear than flannel, and as being of a *softer texture* does not unpleasantly and injuriously *irritate* the skin.

To keep an animal in health, beside the retaining of a due degree of animal heat †, there must be a continued generation of new juices, and a perpetual discharge of the old. Without the due quantity of PERSPIRATION, which with us depends very much on our clothing, neither the vegetable nor animal can continue in health ; a plant whose *perspiration* is stopt becomes sickly and dies ; and an egg whose shell has been covered with a varnish, and the *perspiration* stopt by this means, will produce no living animal either by the application of common heat, or that of incubation from the hen. The celebrated Sanctorius affirms, that the insensible perspiration alone discharges more than all the sensible evacuations together ; and that the proportion of this to all the other evacuations, is as

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* Those consumptive patients, whom *we* hurry off to the clear air in the south of France, the *French physicians*, on the contrary, order to the foggy air of Lyons. As they cannot *both* be right, and as the HOT WELLS favours the sentiments of the latter, being near a great town, where innumerable works are carrying on, and situated on the borders of marshy ground, and a river the most choaked up with mud of any in the world, there is some probable grounds for doubting of the justness of *our* prevailing practice. Vide the Section on *Phthisis Pulmonalis*.

† Vide Sect. XXII. on the Necessity of a due Quantity of Animal Heat to support the Vital Functions, p. 176.

5 to 3: though this proportion varies in different ages, climates, and constitutions, yet is it of such importance in all, that where it is in any considerable degree deficient, a diseased state of the body must ensue. The matter of *insensible perspiration*, or, in other words, the subtle vapour that is continually exhaling from the surface of the body, is not secreted by any particular glands, but seems to be derived wholly from the extremities of minute arteries, that do not terminate in veins, and are every where dispersed on the surface. These *exhaling vessels* are easily demonstrated in the dead subject, by forcing water into the arteries; for then small drops exude from all parts of the skin, and raise up the cuticle, the pores of which are closed by death; and in the living subject a looking-glass placed against the skin, is soon obscured by the vapour. When the perspiration is by any means increased, and several drops, that were insensible when separate, are united together, they form upon the skin those visible drops called *sweat.* This particularly happens after much exercise, or whatever occasions an increased determination of fluids to the surface of the body: a greater quantity of perspirable matter being in such cases carried through the passages that are destined to convey it off.

Now the reason of the propriety of *fleecy hosiery* in *summer* is, that though it promotes the perspiration, it equally favours its *evaporation:* and we know that *evaporation* produces *positive cold,* the *aqueous discharge* being the means designed by nature for carrying off † the superabundant heat, whether arising from climate, exercise, or fever.

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† Vide Sect. XXIII, p. 180, "*On the Means* NATURE *employs to rid herself of too much internal Heat.*" When dogs are exercised, who do not perspire, they carry of the superabundant heat by the *kidneys,* as well as by the *tongue.*

In CHILDREN, where the food is continually combining with oxygen, and the fibres are irritable, it is of the utmost consequence to keep the body temperate, but never to suffer it to get *chilled.* Thus, without being enervated, they may escape the bad consequences arising from the sudden changes in this inconstant climate; for it is not true, that cold hardens *children* as it hardens *steel.* If delicate children are subject to diseases and danger in England, to which they would not be subject in the warmer climate of Italy, is it not evident that *the difference* between the climate of England and Italy is the cause of these diseases and dangers? I firmly believe, says Dr. Beddoes, that the greatest mortality is among those children who are hardly brought up. Nearly one third of the poor, born in this island, sink into the tomb, as soon almost as they have catched a few glimpses of the light of heaven. And even when they have weathered out the early inclemencies of their station, unless they afterwards wear warm and comfortable clothing †, they enjoy no such advantage of freedom from *pulmonic complaints* as we are taught to imagine. Among the peasantry of *Warwickshire* and *Staffordshire,* I am creditably told, says Dr. Beddoes, that *consumptions* are not less frequent, than among the better order of people who are more delicately bred up.

FAT PEOPLE need a less warm raiment than those that are lean; for oil, as being a bad conductor of heat, acts as a fleecy hosiery waistcoat, reflecting back the vital warmth. Here we cannot but admire the benevolent care of PROVIDENCE to the lower order of animals, by giving the whale, the bear, and other animals who inhabit the colder climates, a deep covering of fat or oil.

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† No people are better clothed than the *farmers* in this island, who usually enjoy *rude health.*

3. *The Clothing of old People.*

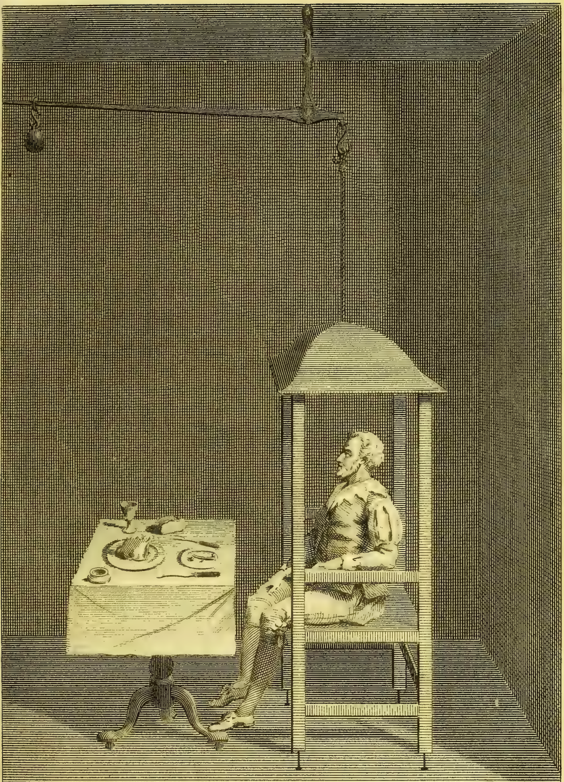
Old people, as requiring *abundant excitement*, ought more especially to be warm clad, and rather to exceed, than to be deficient in the quantity of their clothing, and to wear that which affords them the greatest warmth with the least possible weight. They will not then be liable to be injured by sitting all day in the chimney corner, breathing an unwholesome air, and in a current of wind. A person sufficiently clothed with the *fleecy hosiery* next his skin may wear any slight substance for ornament above it, and will, I am certain, feel more comfortable even at some distance from the fire, than when he was scorching on one side, and felt half frozen on the other.

SECTION XXV.

ON PERSPIRATION.

Now all over the surface of the body, both where there is true cutis under the cuticula, and where there is not, there is a perpetual exhalation, and a waste or dispendium of the liquids in the body, flying off in a subtile vapour.

This exhalation or perspiration, is called *Sanctorian*, from Sanctorius a celebrated Italian physician, who flourished in the beginning of the last century: not that he was the full discoverer thereof, but because he was the first who applied himself to the thorough examination of its quantity by statical experiments; and its proportion to the sensible evacuations; and to find out what causes either promote or obstruct it; and what are the consequences, good or bad, of its increase or diminution.



Lowry ſculp.

Sanctorius in his balance.

London, Pub. by Sherwood, Neely & Jones, 1813

Common sense could not but teach the bulk of mankind that the body perspired. The fouling of clothes without sweat; the sullying of any polished piece of metal or glass by the touch, must have been early demonstrations of it.

That there is a perpetual insensible exhalation from the surface of the body, appears evidently from a variety of phænomena. Hold a polished, dry, clean, rubbed piece of metal, close (without touching) to any bare part of the body, though not sweating, in warm weather, and it will be quickly sullied. Wipe it clean and dry, and hold it again to the part, and the same effect will be constantly renewed.

Fill a clear drinking glass full of cold water (if sal ammoniac is dissolved in it, the experiment will be the more conspicuous, and satisfactory, because it makes the water colder), and hold it near the bare skin, without touching it, and its outer surface will be dimmed, by the vapour exhaling from the skin being condensed by the coldness of the exterior surface of the glass. If you put your naked arm into a wide-mouthed chemical glass vessel, very dry, you will soon see the internal surface of the glass dimmed with the exhalation from the limb. And if it be kept long enough within the glass, there will be seen streaks of moisture trickling down its sides.

And to mention only another experiment, if a person weighs himself when going to bed, and again when he rises next morning, he will often find himself considerably lighter, though he has made no sensible evacuation in that time, either by urine, stool, or sweat.

From all which it is plain, that the body perspires insensibly.

Let us now inquire whence this matter of perspiration comes; and how the evacuation is made.

The cutis vera, as we have said, is supplied with blood vessels, both arteries and veins. Warm water injected into an artery, suppose the axillary artery, reaches to the external surface of the skin †; and being stopped by the

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† When a blister has been applied to the skin of a negro, if it has not been very stimulating, in twelve hours after a bladder is formed, which is the *cuticle* or *scarf skin.* When this fluid and skin is removed, the surface underneath appears black; but if the blister had been very stimulating, the membrane in which this colour resides would have been raised with the cuticle. This is called the *rete mucosum,* which is itself a double membrane, containing a peculiar mucus, which gives the colour to the skin.

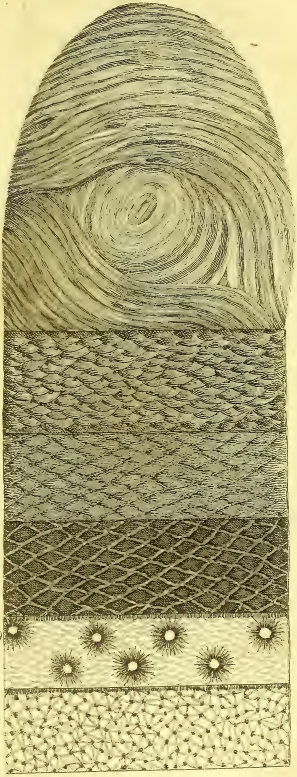
Malpighi first discovered this double membrane in the tongue, and transferred it to the skin covering the body. The scarf-skin or cuticle, is colourless, and the difference in the complexion of the people entirely depends upon the mucus of the *rete mucosum,* being black in the negro, copper-colour in the mulatto, brown in the Egyptian, and white in the Albino, as in the inhabitants of cold climates. With us it becomes brown in those exposed to the beams of the sun, and doubly so when reflected from the surface of the water, as in sea voyages, or from the white sands, as in Africa. The colour of this mucus is transmitted from parents to their children, but is capable of great modification: the offspring of a black man by repeated intermarriages with white women, will in the fourth generation become perfectly white; and the converse of this is equally true.

Immediately under the internal layer of the rete mucosum, Mr. Cruikshank discovered a *third lamen* by injecting the skin of a person who had died of the small-pox, upon which are situated the pustules of this disease. Some have supposed that this was only a suffusion of coagulable lymph betwixt the above-mentioned membranes, and the true skin. We come now to what is called the *cutis vera,* or *true skin,* which is always white in people of whatever complexion they be. It is exceedingly vascular, and endowed with exquisite sensibility. It is extremely elastic, stretching as in dropsy, many feet, and after tapping, returning nearly to its natural dimensions. It is thickest on those parts intended by Nature to bear weight or pressure, and is therefore found to be thickest on the back, the soles of the feet, and the palms of the hands. It is thinner on the forepart of the body, on the insides of the arms and legs, and where its surfaces touch opposite surfaces. On the lips it is extremely thin, so as to allow the colour of the blood to shine through them.

Anatomy of the Skin

as represented by that most eminent Anatomist

Mr. Cruikshank.



London, Pub. by Sherwood, Neely, & Jones 1813

epidermis, whose pores are shut after death, raises it into little vesicles.

This experiment, compared with the circulation in living bodies, shews that the matter of respiration is brought by minute arterial tubes to the surface of the skin; and flies off by pores in the epidermis; though these pores are so extremely small as not to be seen by the help of the greatest magnifiers.

The experiment before mentioned, of the naked arm kept in the chemical glass vessel, shews that water is its basis. But this water is more or less impregnated with animal principles, rendered volatile by the action of the animal heat.—This evidently appears by hounds tracing animals and even their masters at a great distance by the scent.

Those parts of the body which have no cutis, and are exposed to the air, are always moist; and if ever so well dried, quickly become humid again; therefore their perspiration is performed by the small arteries continually pouring out their liquids upon them, which the ambient air constantly licks up, and would soon dry them quite, if there were not a perpetual supply of the same moisture.

Insensible perspiration differs in quantity and proportion to the other evacuations, according to the different circumstances of the individual, in point of climate, diet, and manner of living, age, sex, and temperament.

It likewise varies in the same person in different seasons of the year, in different parts of the same day, and at different spaces of time after meals; and is different in sleep and watching.

And it is affected by exercise or rest; health or sickness; and by the passions.

In general, a warm climate, brisk exercise, if not immoderate, and beyond the strength, youth, health, and vigour, animal diet, promote and increase it.

And the contrary circumstances tend to diminish or obstruct it.

Men perspire insensibly in a general way more than women; which is owing to the greater vigour of their circulation.

And the young perspire more than the old, because the circulation in the former is brisker; the vessels are more yielding and permeable.

We perspire most after a full meal, when the digestion in the primæ viæ is nearly completed, and the blood is most turgid with new chyle, which is now attenuated enough to let its aqueous and volatile parts fly off. Immediately after eating, while the stomach is labouring in the work of concoction, we perspire less than before; but in an hour or two we begin to perspire plentifully; and continue so to do for some hours, till the vessels begin to be empty and the pulse sinks.

We perspire more in the warm part of the day, than in the mornings and evenings. Our pulse is raised by the increased heat of the atmosphere, and our bodies heated of course. Heat increased promotes evaporation; and by the pulse being raised, a greater quantity of perspirable matter is brought to the exhaling vessels of the skin, in a given time.

It hath been much disputed whether we perspire most sleeping or awake. Sanctorius, by his experiments, makes perspiration greatest in sleep: Keill, in his Medicina Statica Britannica, makes it constantly least. The truth of both the facts, as they observed them, is not to be called in question; but how are they to be reconciled?

The Italians, as well as the French, make supper their principal meal: but the English make their dinner their chief meal. Now, as we observed before, perspiration begins to be increased some little time after the stomach is filled; and continues to be plentiful till the vessels become empty: so that with Sanctorius, the time of the greatest perspiration from eating, coincided with the middle of the time of sleep; whereas, with Keill, who often mentions his going to bed supperless, and commonly sat up late, that time of the greatest perspiration arising from eating was over before his bed-time. We are likewise here to take in absorption, of which we shall say more by and by; which, *cæteris paribus*, is greatest when the air is moistest, and when the vessels are emptiest; and therefore no doubt is greater in England than in Italy; and is greater in the night than in the day-time; and greater in one who goes to bed with an empty, than with a full stomach.

You may perhaps be curious to know in what manner Sanctorius made his static experiments. He had a chair hanging by a short beam, near the centre of motion; the beam was continued to a sufficient length, marked at certain distances, in the same manner as stilliards are, by which means a small weight, at a great distance from the centre of motion, might be in æquilibrio with, or outweigh the chair, and himself sitting in it. He knew the weight of his chair, and of his clothes; having weighed himself immediately before, and immediately after eating, he of course found the weight of all the assumpta. And weighing himself immediately before he had any evacuation, he knew their weight, without the uncleanly drudgery of weighing them. By weighing himself at different times, when he had neither eat nor drunk, and had been without any sensible evacuation during the intervals of weighing, he found the quantity of perspiration produced in these intervals.

Sanctorius makes insensible perspiration equal to five eight parts of the whole assumpta.

Keill finds it, at a medium, rather under one half of the assumpta.

Dodart and Gorter, the latter living in Holland, the former in or near Paris, make it somewhat larger than Keill; but nearer the proportion he gives, than that of Sanctorius.

The use of insensible perspiration in the animal œconomy seems to be first to give vent to the oily and saline parts of the blood and humours; which, after having undergone the effects of repeated circulation, if retained, would in time become too acrimonious, volatile, and exalted, to be consistent with that mild balsamic nature in the juices, which is necessary to keep up health, and durable life. And, secondly, as these are expelled, intimately mixed with and dissolved in an aqueous vehicle, highly attenuated, and in the form of vapour, the steam, while it passes, must of course moisten and lubricate the corpus reticulare and epidermis; and likewise the nervous papillæ, preserving the latter in a fit state for sensation.

Sweat may be reckoned and termed sensible perspiration. It arises from the same emissaries that perspiration comes from, there being no good reason to think the outlets of these two discharges to be different. Sweat is produced when the small exhaling arteries, which naturally carry off the matter of insensible perspiration, are so dilated as to let pass a sensible fluid.

While perspiration continues plentiful, and at the same time the body feels light and active, good health is prognosticated, because in this state the humours must be sufficiently attenuated, to part with so many subtle and volatile parts; and all the vessels, from the largest to those that carry off the perspirable matter, which are among the smallest of all in the animal body, must continue tight and permeable; and consequently concoction, circulation, and the various secretions must be duly carried on. But no doubt perspiration may be too great, and weaken, by an over dissipation of our finest fluids. Obstructed perspiration, by penning up the oils and salts of the blood and juices, after they are become acrid by the action of the animal machine, is very probably a frequent cause of irritation. But Keill's tables shew, that in our climate health does not so critically depend upon the regularity of perspiration, as one by reading Sanctorius, would be apt to believe; and that the latter may be often very much diminished, without any remarkable bad consequence. If things were otherwise, how could such a variety of business be carried on in our climate by travellers, all the hours of day and night, by land and by water, in all kinds of weather, which so much influences perspiration, and is so variable and inconstant, as not seldom to be violent in extremes within the compass of a few days, and sometimes hours? We are so made, that, while the body is in health, and vigorous, the defect of one evacuation is made up by the increase of another, and things set right. Upon the whole, I am apt to believe, that too much is imputed to obstructed perspiration, in daily practice; and that the assigning of that cause is often the refuge of ignorance.

SECTION XXVI.

ON THE QUANTITY PERSPIRED.

Sanctorius deserves great commendation for the prodigious pains he took in so nicely and minutely observing, for so long a space of time, the different changes of the quantity of perspiration upon different occasions.

But is it not amazing, that in thirty years space, he should never once have thought on inhalation, or resorption from without? If inhalation, or resorption, is not considered, it is plain, that only the apparent, not the real quantity of perspiration can be found by statical experiments. If, for example, the body, after ten hours, is found lighter than it was by ten ounces, without any sensible discharge, it doth not follow, that just ten ounces, and no more, are exhaled during that space, because two or three ounces might have been gained in the same time by the way of resorption; in which case, the real quantity of perspiration is not ten, but twelve or thirteen ounces, so that weighing the body shews only the excess of the latter above the former, as Dr. Arbuthnot hath, and I believe the first, distinctly and explicitly taught.

"A lad, at Newmarket, having been almost starved in order that he might be reduced to a proper weight for riding a match, was weighed at nine o'clock in the morning, and again at ten o'clock, and he was found to have gained near 30 *ounces* in the course of an hour, though he had only drank *half a glass* of wine in the interval [*]." A gentleman in the city was lately weighed before dinner, and was highly offended to find from his weight, not long after dinner, that he must have eat, unless some deceit was played on him, above *two pounds* of beef-steaks, so much had he increased in weight.

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[*] From Dr. Watson's Chemical Essays.

In the year 1779, Dr. Ingenhousz discovered that the animal body threw out azotic, and fixed, airs. In the very same year, Mr. Cruikshanks, the celebrated author of a work on the absorbent system, and Lecturer on Anatomy in London, published a similar discovery; and in justice to both characters, I must observe, as I heard from Dr. Ingenhousz, that their respective works were in the press at the same time. This however is not the only instance of two persons, ignorant of each other's pursuits, happening to hit upon the same thing. Nothing was more simple than the experiment of these philosophers; the hand was immersed under quicksilver and the bubbles of air collected, and it was discovered, that the discharge from the surface of the body was,

1. Two parts *fixed air*.
2. One part *azotic air*, and
3. A quantity of *aqueous fluid*, which contained the different salts of the body.

To these discoveries, confirmed by Mr. Abernethy, Lecturer on Anatomy at Bartholomew's Hospital, was added an important fact, that the absorbents had the power of separating the oxygen air from the azotic, that is, of decomposing our atmosphere, as also of absorbing fixed and other airs.

EXPERIMENT I.

Thermometer between 50° *and* 60°.

I filled and inverted, says Mr. Abernethy, a jar in quicksilver, and threw up into it one measure of atmospheric air, which could contain seven ounces of water. The quicksilver was depressed two inches and a half from the top of the jar. After moving my hand ten minutes beneath the surface of the quicksilver, to detach any common air which might adhere to it, I put it up into the air in the jar, and there retained it for the space of an hour. Before I withdrew my hand, I depressed it beneath the surface of the quicksilver, still keeping it within the glass, and agitated it in this situation, for ten minutes; this was done that I might not remove any of the air, which was the subject of the experiment. The same conduct was pursued in all the subsequent experiments. After five hours exposure of the hand to this air, the quantity in the glass was *diminished* about *half an ounce*. It might have been expected that the *perspiration* would have increased the bulk of the air, but in this experiment, the *absorption* seemed to surpass in quantity the secretion.

I now threw up into the jar lime water, by which nearly an ounce of air was rapidly absorbed, and the lime was precipitated; the remaining air being examined by the addition of nitrous gas, was found to contain nearly one-sixth less of oxygen gas, than it did before the experiment.

In another similar experiment, after the hand had continued nine hours in the air, I found more than one ounce measure of carbonic gas, or fixed air, had been produced, and the remaining air being examined by the eudiometer, contained one-fourth less of oxygen than before the experiment.

It might, perhaps, here be inquired, does the oxygenous gas of the atmosphere contribute to the formation of the carbonic gas?—Both reason and experiment reply that it does not, for if oxygenous gas combined with carbon on the surface of the skin, much heat should be produced at the time of their combination; but this production of heat is not found to take place. Experiments also shew that carbonic gas is perspired from the vessels, for into whatever air the hand be immersed, the quantity of carbonic gas given out will be nearly the same. This is a point which I have determined by careful experiment.

EXPER. II.

Having filled and inverted a jar in quicksilver, I put up into it a seven ounce measure of *azotic gas.* I pursued the plan related in the former experiment, to avoid adding to, or abstracting from, this air. After two hours exposure of the hand, on throwing up lime water a rapid and considerable diminution of air followed; so that rather more than an ounce of carbonic gas was produced, when no oxygen was present. The increase of the quantity of carbonic gas is accounted for in this experiment, by the heat of the atmosphere being greater, which disposed the skin to more copious perspiration.

I made similar experiments with the *hydrogenous* and *nitrous gases*; in these an equal quantity of carbonic gas was produced; and when the hand was surrounded by oxygen, the quantity of carbonic gas was not much greater.

EXPER. III.

Thermometer about 50°.

I next wished to discover what effect the action of the hand would produce on carbonic gas.

Into a glass jar filled with, and inverted in quicksilver, I introduced six ounces of *carbonic gas,* and exposed my hand to it, for the space of nine hours, in the manner, and with the precautions, before related. In that time the air was reduced in quantity to less than three ounces. A portion of the carbonic gas was examined, by the addition of lime water, before the experiment, when it was almost wholly absorbed; an unexaminable bubble only remained. When the remaining gas was examined by lime water, after the experiment, a considerable quantity of *azotic gas*, which doubtless exhaled from the hand, was found mixed with it.

I twice repeated this experiment, with similar events, though with rather less diminution in the quantity of carbonic gas; it was, however, sufficiently evident, that the absorption of this gas, by the skin, was very copious and rapid.

EXPER. IV.

Thermometer 80°.

The absorption of carbonic gas makes it difficult to ascertain precisely the quantity perspired, since that gas which is thrown out from the body by secretion, will probably be readmitted by absorption. I therefore wished to discover the quantity of carbonic gas perspired in one hour.

The hand being retained one hour in five ounces of nitrous gas, no ascent nor depression of the quicksilver was remarked. On the introduction of lime water into the glass, *six drams* of carbonic gas were absorbed.

In a similar experiment with atmospheric air, after the expiration of an hour, the quicksilver had rather risen, and *three drams* of carbonic gas were discovered by lime water. In another experiment, in which hydrogenous gas was employed, *four drams* of carbonic gas were found at the termination of an hour.

All the last related experiments were performed in very hot weather. If two drams of carbonic gas were emitted in an hour, as the quantity usually obtained in five hours was but one ounce, it would be a sufficient demonstration of the absorption of a part of the air perspired. Neither are these experiments conclusive as to the precise quantity of air emitted, for even in an hour part of that which is exhaled will be again imbibed. When I first attempted the experiments with carbonic gas, I supposed that the absorbents would receive it reluctantly, for I thought that matter which was thrown out from the skin in such quantities, could neither be requisite nor salutary to the body. The experiment proved that I was mistaken, and there are reasons which tend to shew the salubrity of this gas. When it is admitted into the stomach, it is generally found beneficial. When employed as a local application, its stimulus is useful, and when in combination with the blood, it probably produces equally serviceable effects.

EXPER. V.

Thermometer between 60° *and* 70°.

The experiments that have been related, indistinctly shew, that a small quantity of one kind of air, when mixed with a larger portion of another, can be abstracted from it by the action of the animal body. This circumstance will be hereafter fully proved. I will now relate an experiment that was made in support of this opinion, as it was performed beneath quicksilver, and in the same manner with those which immediately precede it.

Into a jar filled with, and inverted over quicksilver, three measures of *azotic* gas and three of *carbonic* were introduced; the two airs depressed the quicksilver two inches and a half, and occupied the space of seven ounces of water. After five hours exposure of the hand, the air contained in the jar filled the space of only five ounces and a half of water; on putting up lime water to this air, it was diminished to three ounces. In this experiment one ounce and a half of carbonic gas appears to have been removed, and half an ounce of azot; but if you admit that one ounce of carbonic gas was perspired during this experiment, and one third of an ounce of azotic, the quantity of air estimated to be absorbed is increased, but the proportions remain unaltered.

EXPER. VI.

Thermometer 60°.

In the experiments with common air I have mentioned, that it contained less oxygen after it had undergone the operation of the hand, than before it became the subject of experiment. A question here occurs, does this variation proportionably arise from the addition of the one gas, or the removal of the other? That it is owing to absorption, will, I believe, be evident, from the following experiments. Although the addition made to any kind of air, cannot be accurately ascertained when water is employed, yet if the hand removes any portion of air, that removal will be ascertained by examination, neither does the experiment appear liable to deception. In the experiments next related the air was confined by water; this gave me an opportunity of using larger vessels, and exposing a greater extent of surface of the skin to the contact of the air. I forbore particularly to remark the quantity of air absorbed in the foregoing experiments, for though it corresponded to those which I shall next relate, yet the correspondence was not uniform, and the degree of absorption was less evident.

I filled and inverted a jar in water, and put up into it twenty-four ounces, by measure, of *atmospheric air*; to this the hand was exposed for twelve hours, the same precautions being used to avoid adding to, or taking from the air contained in the jar. The water had risen in the vessel, and about two ounces and a half of the air were removed; that which remained was examined by the eudiometer, when two measures of it, and one of nitrous gas, filled the space of nearly two measures, and one third of another; it therefore follows, that about one half of the usual quantity of oxygenous gas was removed from the other part of the atmosphere. That there could be no addition of nitrogenous gas capable of so greatly altering the proportions of these gases, must, I think, be too evident to need argument for its proof. Similar experiments were afterwards made with correspondent events. In the experiments made under quicksilver, the abstraction of oxygen was equally evident, and considerable; it therefore appears, that the animal body is capable of taking away the oxygen, when in intimate mixture, with a much greater quantity of azot. The avidity with which oxygen is absorbed, will be made still more conspicuously evident by the following comparative experiment.

EXPER. VII.

I filled and inverted two jars in water, into one I put twenty-four ounces by measure of *azotic* gas, into the other the like quantity of *oxygen.* The hand was put into these airs alternately, and retained there for an hour each time: after it had been exposed to each for eight hours, the water rose one eighth of an inch in the bottle containing the azotic gas, and nearly a whole inch in that containing the *oxygen.* On estimating the quantity removed, by weighing the water which filled the bottles to the different marks, it appeared that *one twentieth* part only of the *azotic gas* was removed, but *one-third* of the *oxygenous gas* was gone. The remaining oxygenous gas was found to contain one eighth more of azotic gas than before the experiment. I next examined the degree of celerity with which other gases would be imbibed.

EXPER. VIII.

Having filled and inverted a jar in water, and put into it thirteen ounces of *nitrous gas*, I retained my hand in this air, at different times, five hours, in which time three ounces were absorbed. My hand being retained for as many hours in a like quantity of *hydrogen gas*, not more than one ounce and a half was removed.

The removal of a quantity of *oxygen gas* from common air, is surely a curious circumstance; if this be the effect of an action in the absorbing vessels, it must much exalt our ideas of their subtility, and their aptitude, or disposition, to admit one species of matter and to reject another. That the abstraction of one air, in preference to another, depends upon this cause, I believe will not, on reflection, be doubted; it might indeed be suspected, that oxygenous gas was separated from the atmosphere by the skin, as it is in the lungs by chemical attraction: but it has been proved that *carbonic* gas is removed with equal celerity; and experiments on animal substances shew in them a disposition rather to part with than to imbibe carbonic gas. The removal of this air is therefore not likely to be the effect of chemical affinity. The different degrees of celerity with which other gases are admitted, seem to establish the opinion, that the removal of one kind of air in preference to another is the effect of an active *selecting power* in the absorbing vessels.

The experiments which have been related satisfactorily prove the quality of the aeriform perspiration; perhaps the proportions may occasionally vary, but, as nearly as I can determine, it consists of rather more than *two parts* of *carbonic*, with the remainder of *azotic gas*. The quantity of the matter perspired is with less certainty ascertained; in one hour I obtained *four drams of carbonic gas:* but it should be remembered, that these experiments were made in very hot weather; and it also deserves notice, that the quantity of the cutaneous perspiration is subject to great variety. In every experiment *absorption* was found to be equal to *perspiration*, in many it was much more copious; especially when the air to which the skin was exposed was salutary to the constitution. The *oxygenous* and *carbonic* gases are very readily imbibed; whilst the *nitrous*, *hydrogenous*, and *azotic* gases, tardily gain admittance into the absorbing vessels. In Experiment V. from about half of the surface of the hand two ounces and a half of carbonic gas were absorbed in five hours; in other Experiments, from the hand and wrist there was imbibed,

In eight hours 8 ounces of oxygenous gas.
In five hours 3 do. - nitrous gas.
In five hours 1 ½ do. - hydrogenous gas.
In eight hours 1 do. - azotic gas.

EXPER. IX.

Thermometer 65°.

I next endeavoured to ascertain the quantity and quality of aqueous perspiration.

I introduced my hand and fore-arm into a glass jar, covered with bladder; an aperture was left in the bladder, to admit my arm, round which the bladder was tied; so that the ascent of any vapour was prevented. In six hours I procured nearly *three drams* of limpid tasteless *water*. The quantity collected corresponds with the result of Mr. Cruikshank's experiments, who obtained the water of perspiration in the same manner. Half of this liquid was evaporated by a gentle heat; there remained a small residue on the glass, which had a very slight taste of *salt*. The other half was suffered to stand many days, in which time no change appeared: it did not then alter the colour of the vegetable blue. Into one portion of this watery liquor marine acid was dropped, which caused no coagulation, or precipitation of animal matter: into the other some caustic alkali was poured, which produced no visible effect. I therefore conclude that the water of perspiration, in a state of health, contains little, or any thing, except a very small portion of salt.

Perspiration is generally said to be sensible, or insensible; perhaps it may be better distinguished as *aeriform* or *watery*. It may be expected, that a general estimate of the quantity of this secretion should be attempted; but the difficulties which oppose any accuracy of statement are considerable. In these experiments the process was not continued under its usual circumstances; the arm was surrounded by water, or quicksilver; and when in the latter fluid, the circulation was in some degree interrupted by its ascension, and pressure against the edge of the jar.—For the uncertainty which these circumstances occasion, allowance must be made, but before an estimate of the quantity of perspiration be attempted, the extent of the body should be known. Mr. Cruikshank supposes the extent of the hand to be to that of the body as one to sixty: it is much more, according to my computation.

After ineffectually endeavouring in different ways to measure the surface of the body, I concluded that I should approach nearest to its true extent by measuring the circumference of the trunk and limbs at different parts, and having thus obtained the mean circumference, I could then calculate the extent of their surface, as if they were cylinders, the dimensions of which were ascertained. The surface of the head, hand, and foot, I computed, by applying paper, cut as the occasion required, over these parts: afterwards placing the separate pieces of paper so as to form an extended plane, I measured its extent. I shall mention these measurements, that the reader may correct them if he should think them in the least erroneous. If a man be five feet six inches high, I will suppose the mean circumference of the trunk of his body to be thirty-three inches, and its length, from the top of the sternum to about the hip, twenty-two inches.

	Square Inches
The extent of surface of the trunk will therefore be	726
The circumference of the neck 13 inches, its length from the sternum to the chin 3 inches..........	39
The surface of the head, and back of the neck....	286
The mean circumference of the arm 10 inches, its length 12. Surface of both arms	240
The mean circumference of the fore-arm 8 inches, its length 10. Surface of both fore-arms..........	160
The surface of the hands and wrists measuring to the extremities of the bones of the fore-arm........	140
The mean circumference of the thigh 17 inches, its length 16. Surface of both thighs............	544
The mean circumference of the leg 11 inches, its length 14. Surface of both legs..............	308
Surface of both feet.........................	182
Allow for folds of the skin, inequalities of the surface, &c.	175
The extent of the surface of the body will be....	2700

The superficial extent of the hand and wrist, according to this calculation, is to that of the body as one to about thirty-eight and a half.

In Experiment IV. the least quantity of *carbonic gas* emitted from the hand, in one hour, was three drams by measure; it may be supposed that the heat of the weather increased the secretion from the skin, let us therefore consider two drams as the ordinary quantity. If then the perspiration of all parts were equal, *seventy-seven dram measures of carbonic gas* and *one third* of *that quantity* of *azotic gas*, would be emitted from the body in the space of *one hour*. If we also suppose perspiration to be at all times equal, nearly *three gallons of air* would be thrown out from the body in the course of *one day*.—Although the quantity of air perspired is so large, yet the weight of the body will not be much altered by its loss; it is the *aqueous perspiration* by which this will be principally diminished. When the thermometer was between 60° and 70°, I obtained about *thirty grains* of *fluid* from my hand and part of the fore-arm in an hour; the surface from which this secretion was made I compute to be one twenty-fifth part of the extent of the body. The supposition being allowed, that perspiration is at all times, and in every part, equal, about *two pounds and a half* is the loss of *water* which the body would in one hot day sustain. In most of the experiments which I have made, the *absorption* of air was equal to the *perspiration*; in many, it was much greater, especially if the air was salubrious to which the skin was exposed. Experiment VI. makes it appear probable, that if the *naked body* was exposed to fresh currents of the atmosphere, that only the *oxygenous* part would be absorbed; the decomposition of which, in the body, would produce an increase of animal heat; which might, in some degree, make up the loss sustained by the exposure. Our *clothing* probably prevents, very much, this effect, and perhaps makes it less necessary. If the perspired *carbonic gas* be confined by our garments, it seems likely that it will be taken up again by the absorbents. Whether the body does usually imbibe *water* from the atmosphere, adequate to the loss sustained by aqueous perspiration, is uncertain. But I am inclined to suppose, that the absorption of *air* from the skin is nearly equal to the secretion.

SECTION XXVII.

ON CLEANLINESS.

The under garment of *fleecy hosiery* ought to be frequently changed, as it promotes the perspiration, and is continually absorbing it. Diseases of the skin are chiefly owing to want of cleanliness. They may indeed proceed from other causes; but they seldom continue long where cleanliness prevails. To the same cause must we impute the various kinds of vermin which infest the human body, &c. These may always be banished by cleanliness alone, and wherever they abound, we have every reason to believe it is neglected. It is remarkable that, in most eastern countries, cleanliness makes a great part of their religion. Indeed the whole system of the Jewish laws has a manifest tendency to promote cleanliness. Whatever pretensions people make to politeness and civilization, I will affirm, that as long as they neglect cleanliness, and appear nasty, they are justly styled Goths and barbarians.

Few things are more unreasonable, than the dread of cleanliness in sick people. They had rather wallow in all manner of filth, than change a tatter of their apparel. Yet how refreshed, how cheerful, how comfortable do people feel, when in health, upon being shaved, washed, and shifted! If cleanliness be proper for persons in health, it is certainly more so for the sick. By being neglected the slightest disorders are often changed into the most *malignant*. The same mistaken care which prompted people to prevent the least admission of *fresh air* to the sick, seems to have induced them to keep them dirty. If the *fleecy hosiery* waistcoat was changed on going to bed, which is the time we are in the habit of being exposed to cold, there can be no danger of catching cold, nor can there be any impropriety of doing this at least twice a week in the summer, and once in the winter. The only caution necessary, is to see, previous to its being put on, that it contains no dampness.

Cleanliness is certainly agreeable to our nature. It sooner attracts our regard then even finery itself, and often gains esteem where that fails. It is an ornament to the highest as well as the lowest station, and cannot be dispensed with in either.

I had occasion, says the author of the Spectator, to go a few miles out of town, some days since, in a stage coach, where I had for my fellow travellers a dirty beau, and a pretty young quaker woman. Having no inclination to talk much, I placed myself backward with a design to survey them, and to pick a speculation out of my two companions. Their different figures were sufficient to draw my attention. The gentleman was dressed in a suit, the ground whereof had been purple, as I perceived from some few spaces that had escaped the powder, which was incorporated with the greatest part of his coat: his perriwig, which cost no small sum, was after so slovenly a manner cast over his shoulders, that it seemed not to have been combed since the year 1682; his linen, which was not much concealed, was daubed with plain *spanish,* from the chin to the lowest button; and the diamond upon his finger (which naturally dreaded the water) put me in mind how it sparkled amidst the rubbish of the mine, where it was first discovered.

On the other hand, the pretty quaker appeared in all the elegance of cleanliness. Not a speck was to be found upon her. A clear, clean oval face, just edged about with little thin plaits of the purest cambric, received great advantage from the shade of her black hood; as did the whiteness of her arms from that sober coloured stuff in which she had clothed herself. The plainness of her dress was very well suited to the simplicity of her phrases; all which put together, though they could not give me a great opinion of her religion, they did of her innocence.

This adventure occasioned my throwing together a few hints upon *cleanliness*, which I shall consider as one of the *half virtues*, as *Aristotle* calls them, and shall recommend it under the three following heads: as it is a mark of politeness; as it produces regard; and as it bears analogy to purity of mind.

First, It is a mark of politeness. It is universally agreed upon, that no one unadorned with this virtue can go into company without giving a manifest offence. The easier or higher any one's fortune is, this duty arises proportionally. The different nations of the world are as much distinguished by their cleanliness, as by their arts and sciences. The more any country is civilized, the more they consult this part of politeness. We need but compare our ideas of a female *Hottentot* and an *English* beauty, to be satisfied of the truth of what has been advanced.

In the next place, cleanliness may be said to be the foster mother of love. Beauty indeed most commonly produces that passion in the mind, but cleanliness preserves it. An indifferent face and person, kept in perpetual neatness, has won many a heart from a pretty slattern. Age itself is not unamiable, while it is preserved clean and unsullied; like a piece of marble constantly kept clean and bright, we look on it with more pleasure than on a new vessel that is cankered with rust.

I might observe *farther*, that as cleanliness renders us agreeable to others, so it makes us easy to ourselves; that it is an excellent preservative of health; and that several vices, destructive both to mind and body, are inconsistent with the habit of it. We find from experience, that through the prevalence of custom the most vicious actions lose their horror, by being made familiar to us. On the contrary, those who live in the neighbourhood of good example, fly from the first appearance of what is shocking. It fares with us much after the same manner as to our ideas. Our senses, which are the inlets of all the images conveyed to the mind, can only transmit the impressions of such things as usually surround them. So that pure and unsullied thoughts are naturally suggested to the mind by those objects that perpetually encompass us, when they are beautiful and elegant in their kind.

SECTION XXVIII.

ON FOOD.

At first, the food passes down the *œsophagus* *, or gullet, and is taken into the *stomach* † retaining its peculiar pro-

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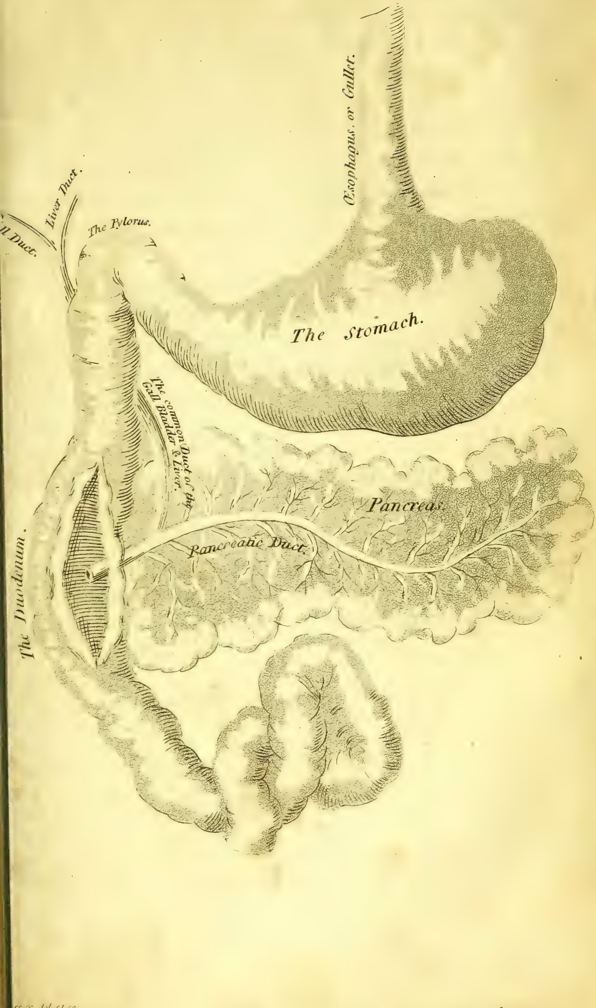
* The *œsophagus,* or gullet, is composed both of *longitudinal,* and *circular fibres,* but chiefly *circular,* abundantly more so than in the intestines; because this has no foreign power to assist it, and because it is necessary the food should make a shorter stay here than there. Hence it is that horses drink against the law of gravity. The inner surface is a smooth membrane, abundantly supplied with *mucilage,* to sheath this organ, and render the passage of the aliment easy.

† *The stomach* is situated on the *left side* below the short ribs. The right side of the stomach is covered by the thin edge of the left lobe of the *liver;* the left presses on the *spleen.* Its figure nearly resembles the pouch of a bag-pipe, its *upper side* being concave, and the *lower* convex, and its *left end* most capacious. The entrance into the *œsophagus* on the left side is called the *cardia;* on the right, where the chyme passes into the *duodenum,* is named *pylorus,* where there is a *circular valve,* or *sphincter muscle,* which hinders a regurgitation of the aliment. The stomach has *circular* and *longitudinal fibres,* and its *inner membrane* is bedewed with a strong and viscid mucus.



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London, Pub. by Sherwood, Neely & Jones, 1813

perties, *irritates* the inner coat of that organ, and occasions a contraction of its two orifices. The food, thus confined, then undergoes a constant agitation by means of the abdominal muscles, and of the diaphragm, and by the motion of the fibres of the stomach itself. By these movements, every part of the food is exposed to the action of a fluid secreted in the stomach, called *the gastric juice*, which (as water dissolves sugar) gradually dissolves and attenuates the food (as presently will be proved*), and prepares it for its passage into, and farther change in, the intestines.

The painful sensation of *hunger*, which is the irritation of the gastric juice on the inner coat of the stomach, or the sensation of a defective supply of chyle in the arterial system †, being removed by the food, we soon feel a mild and undescribable delight, first from the stimulus of the aliment; and secondly, from the distention of this, and the increased action of other parts.

If it should seem strange that *pleasure* arises from *the stimulus* of food on the sentient nerves of this important organ, let us recollect only the effect of a moderate dose of *opium* to those unaccustomed to *that stimulus*. They are commonly so transported with the pleasing sensation it induces, that they feel, as they oftentimes express themselves, as though they were in heaven, and enjoy so perfect a pleasure, that no happiness in the world can surpass the charms of this agreeable ectasy. On the other hand, what a terrible agony will two or three grains of *crocus metallorum* throw the whole fabric into? this part being of so acute a feeling, that some philosophers have for this reason thought it to be the seat of the soul itself.

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* In the next Section.

† Nothing better illustrates this, than what happened to Admiral Byron, Captains Cheat and Hamilton, when shipwrecked on the west coast of South America; who, after suffering months of hunger and fatigue, were reduced to skin and bone. A table, says Byron, was spread out for us by the Indians, with cold ham and fowls, which only we *three* sat down to, and in a short time we dispatched more than *ten* men with common appetites would have done, and yet we complained of being *unsatisfied*. For a long while we got up two or three times in the night to cram ourselves. Captain Cheat used to declare, that he was quite ashamed of himself.

Besides this consideration, we must here take notice, that the stomach being distended with food, presses on *the spleen* *, and thereby occasions a greater quantity of blood to pass into the *pancreas*, and consequently a greater increase of the secretion from that viscus;—and by obstructing in some degree the passage of blood in the descending trunk of the *aorta*, causes an increased flux of blood to the *head*, and hence, after a full meal, inactivity and drowsinesss † and sometimes apoplexy ‡ ensue; and hence also proceed those flushings or redness in the face, so conspicuous in weak and exhausted persons, after eating.

We will now attempt to trace the food in its digested form, after it is thrown out from the stomach into *the intestines*.

The aliment having remained during two or more hours in the stomach, is converted, first, into a greyish pulp, which is usually called *chyme*. This chyme, or fluid,

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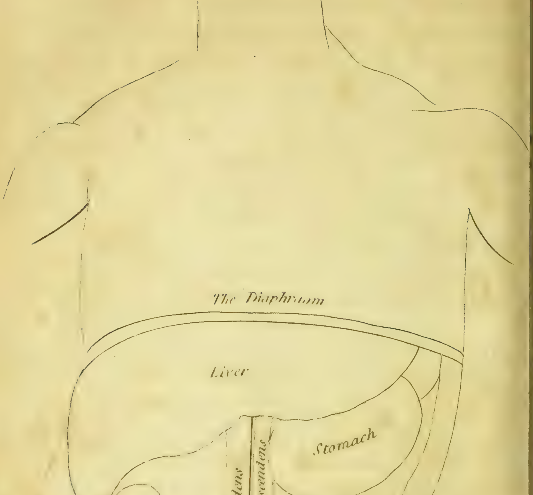
* The true office of the SPLEEN was *the happy discovery* of the ingenious Dr. Haighton, Lecturer on Physiology to the Pupils of Guy's and St. Thomas's Hospitals. It did not escape the penetrating mind of the Rev. Mr. Townsend, and this coincidence of thought is a further proof of its truth. See *the Elements of Therapeutics*.

† Mr. Brindley, the famous canal engineer, mentioned to Dr. Darwin that he had more than once seen the experiment of a man extending himself across the large stone of a corn-mill, and that by gradually letting the stone whirl, the man fell fast asleep. Dr. DARWIN.

‡ See *Townsend's Elements of Therapeutics*.



Map of the Internal Abdominal Viscera, the External or Bow
being removed.

London Pub. by Sherwood Neely & Jones, 1813.

passes out of the *pylorus*, or right orifice of the stomach; the fibres of which relax to afford it a passage; while the grosser and less altered particles remain in *the living retort*, to adopt the expression of the Reverend Mr. Townsend, till they acquire a sufficient fluidity, to pass into the intestinal canal. As the digested food enters the *duodenum* *, it stimulates the common duct of the *gall bladder* and the *liver*, and from a law in the animal œconomy, which has given the highest sensibility to the nerves at the mouths of the several ducts, which, by a sympathetic communication, occasions their several glands either to secrete or pour out a greater quantity of fluid, the *chyme* receives a full supply of *bile* †, and of *saliva*, secreted from the *pancreas* ‡; it also intermingles with *mucus* from innumerable exhalent arteries, which still farther animalizes the chyme.

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* Vide the Map of the Viscera.

† The *liver* is the largest gland in the body, of a dusky red colour, immediately situated under the vaulted cavity of the *diaphragm*, or midriff, chiefly on the *right side*, and somewhat on the *left* above the *stomach*. Exteriorly, or anteriorly, it is convex, inwardly it is concave; very thick in its superior part, and thin in its inferior. The upper side adheres to the diaphragm, and it is fixed to this, and the sternum, or breast bone, by a broad ligament, called *suspensorium*. It is also tied to the navel by a ligamentous band, called *teres*, which is the umbilical vein of the fœtal state degenerated into a ligament. Both these bands serve to suspend it, while lying on the back, from bearing too much on the subjacent *cava*, or otherwise it might press on this important returning vessel, stop the circulation, and put a period to life. Dogs and cats, and other animals, who are designed for leaping, have their liver divided into many distinct lobules which prevent a too great concussion of this viscus. Ours is divided into *two lobes*, of which the right is considerably the largest.

‡ The *pancreas* is a large gland, which lies near the stomach, and discharges by a short duct, into the intestines, a liquor, which it separates from the blood. It is difficult to collect any quantity of this juice, because it is not lodged in any particular receptacle, but flows from the gland into the intestines, near the upper orifice of the stomach. However in dogs this has been executed by tying a bottle near the duct of the gland, while the animal was living, by which a quantity of the juice has been collected, and found in appearance to resemble the *saliva*.

The *intestinal canal** is five times as long as the body, and forms many circumvolutions in the cavity of the

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* The *intestinal canal* is usually five times the length of the individual. It is curiously convoluted in the abdomen. This space anatomists have thought fit to divide into 6 *portions*.

1st. The *duodenum*, because it is commonly reckoned in adults to be 12 inches long.—At a small distance from where the stomach joins it, the *common gall duct* and the *pancreatic duct* open into it; from the one it receives the *bile*, and from the other the *pancreatic juice*.

2d. The *jejunum*, from its being in general found *empty*, on account of the fluidity of the chyme, the stimulus of this, and the bile, and the prodigious number of lacteals.

3d. The *ileum*, because of its situation near the pelvis, where the bones projecting like the wings of a pheaton are called *Ilea*.

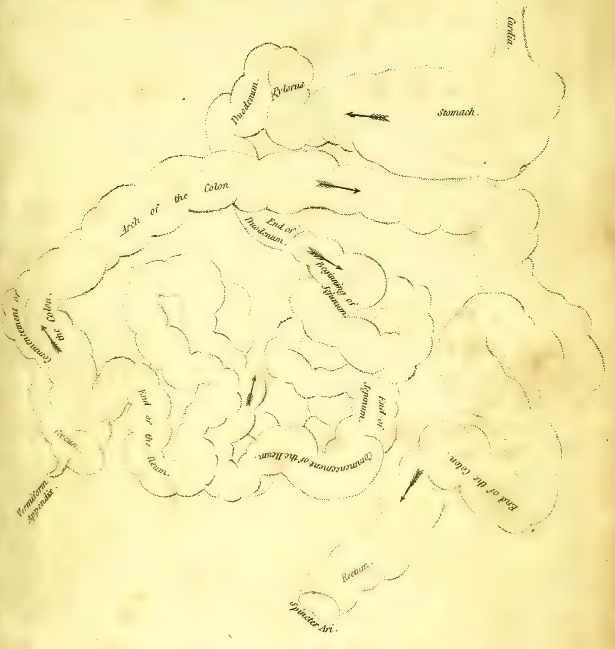
4th. The *colon*, which takes an arched direction.

5th. The *cæcum*, or *blind gut*, a pouch, as it were, of the colon, about 3 inches long, and called *blind* from its being out of the direction of the passage of the food. Its diameter is twice as large as that of the other intestines. It has an *appendix*, called *vermiform*, whose use is not well ascertained, which floats loose in the abdomen, and in the mackerel there may be seen above 150 of them.

6th. The *rectum*, or *straight gut*, is the last, and at its termination is surrounded by *circular muscular fibres*, called the *sphincter ani*.

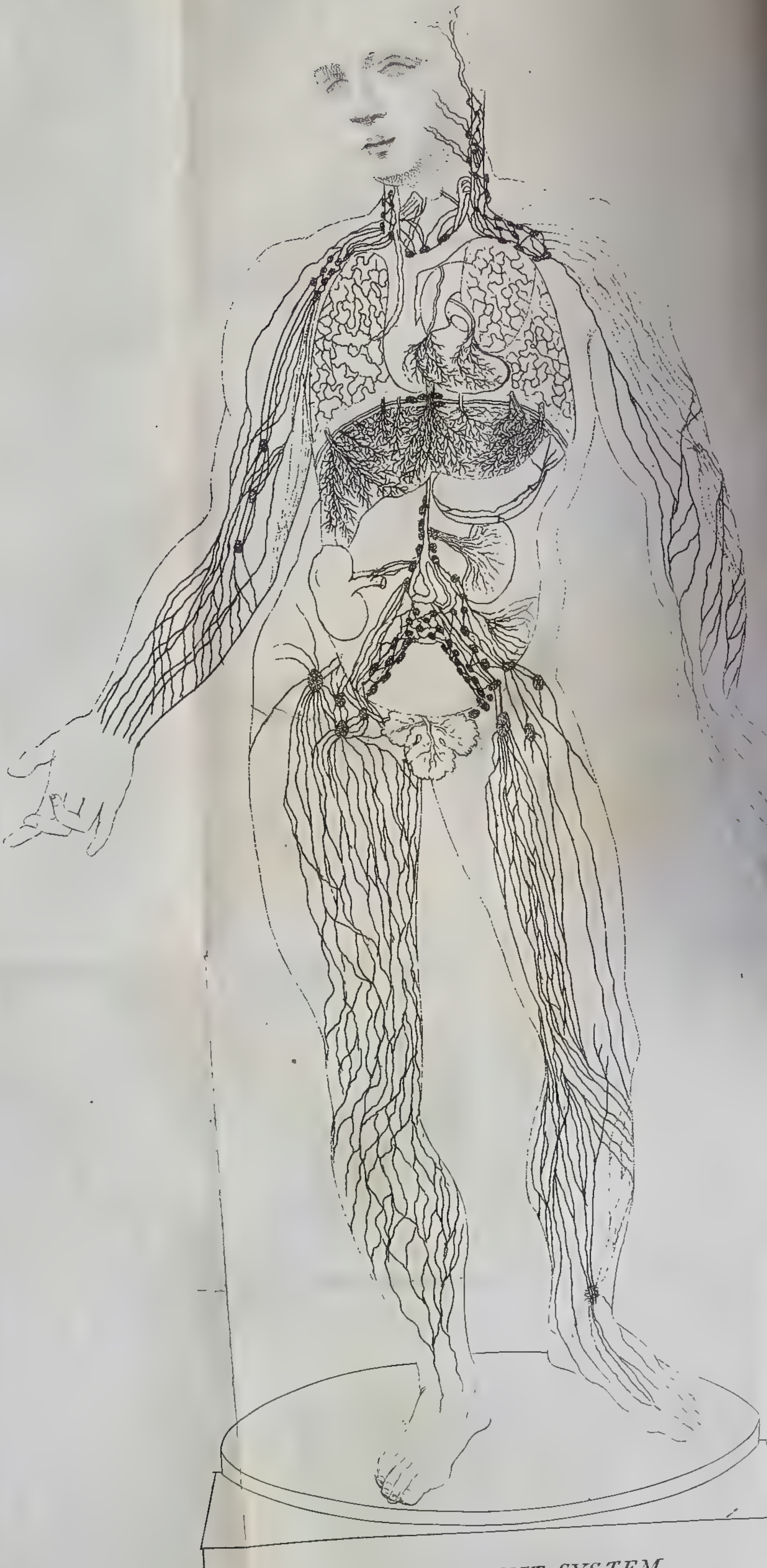
The *three* first are termed the *small guts*, the *three* last the *great*. In the *small guts* there are numerous *plaits* to detain the food, and allow a wider surface for its absorption. These are larger, and far more numerous near the stomach, where the food is thinner, then they are towards the colon. At the entrance of the *ileum* into the *colon*, there are two *very large valves*, which prevent the regress of the fæces into the ileum. The *cæcum* and *colon*, besides having stronger muscular coats than the small intestines, are furnished with three *ligamentous bands*, running lengthwise on their outside, dividing their surface into three portions nearly equal. Though these appear like ligaments externally, they are made up in their inner structure of true muscular fibres. The ligament-like bands, which in the cæcum and colon are collected into *three* portions, are spread *equally over* the surface of the *rectum;* a wise precaution of nature, that no part of it may be weaker than another, lest it should give way in the efforts of

17 THE INTESTINAL TUBE, OR PRIMÆ VIÆ.



To face P. 81, of Vol. I.

London, Pub. by Sherwood, Neely & Jones, 1813



THE ABSORBENT SYSTEM

From Mr. Cruikshank's admirable History of the Absorbents.

London Pub by Sherwood Neely & Jones 1815 abdomen, which it traverses from right to left, and again from left to right. The inner coat of the intestines, by being more capacious than their exterior tunics, occasions a multitude of *plaits* *, at certain regular distances from each other, and these become less and less, and at farther intervals as they descend. This disposition will be found to afford a still farther proof of that divine wisdom, which the anatomist and physiologist cannot fail to observe in all their pursuits; for if the intestinal canal was much shorter than it is; and if its inner surface was smooth and destitute of plaits; the aliment would consequently pass with great rapidity to its termination, and sufficient time would be wanting to assimilate, the chyme, and for the necessary absorption of it by the numerous *villi*, or hair-like projections which terminate in *lacteals* ‡: so that the

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egestion. The plaits are considerably fewer in the great guts. They have *all* an *inner membrane*, studded with an infinite number of arteries, or glands, which pour out a lubricating fluid. They have *muscular fibres* both *circular* and *longitudinal*.

[*] Called by anatomists *valvulæ conniventes.*

[‡] I think I have proved, says the illustrious Dr. Hunter, that the lymphatic vessels are the absorbing vessels, all over the body; that they are the same as the lacteals; and that these altogether, with the thoracic duct, constitute *one great* and *general system*, dispersed through the whole body for absorption; that this system *only* does absorb; that it serves to take up, and convey, whatever is *to make*, or *to be again mixed with the blood*, from the intestinal canal, from the skin, and from all the internal cavities and surfaces whatever. In our times, after schools of anatomy have long flourished in all the civilized nations of Europe, and when, from the number of men who have been employed in such researches, it might have been imagined that discoveries were exhausted, PROVIDENCE has allowed me a greater share of that sort of honour, than at first I could have expected. My discovery of the ABSORBENT SYSTEM gains credit daily, both at home and abroad, to such a degree, that I believe we may now say, that it is almost universally adopted: and, if we mistake not, in *a proper time*, it will be allowed to be the *greatest discovery*, both in *physiology* and

body, unless constantly replenished, would be deprived of the supply of nutrition, which is so essential to life and health :—but the length and circumvolutions of the intestines, the inequality of their internal surface, and the course of the aliment through them, all concur to perfect the separation of the chyle from the fæces, and to afford the necessary nourishment to the body.

SECTION XXIX.

OF THE GASTRIC SOLVENT, AND THE RELATIVE DIGESTIBILITY OF FOOD.

In serpents, some birds, and several kinds of fish, which swallow whole animals, and retain them long in their stomach, *digestion* seems to be performed, says Cheselden, by *some unknown menstruum*; for we frequently find in their

in *pathology*, that anatomy has suggested, since the discovery of the circulation of the blood.

Having ventured to throw out, continues Dr. Hunter, so bold a proposition, that my reputation may not suffer through want of a little reflection upon the subject, I must beg leave to explain my opinion. The discovery of a duct of a gland, an undescribed muscle, an artery, or a concealed vein, all such discoveries certainly are trifling, when compared with the introduction of a *new* and *general system*, which is interwoven with, and performs a peculiar and important function in every part of the body; so *important*, indeed, that it was necessary, and accordingly has since actually been found out in brutes, likewise in birds, and in fish. *Such is the discovery* of the ABSORBENT SYSTEM : and every person, who is really an anatomist, or physiologist, will, upon a little reflection, admit what has been here advanced; and, looking over the whole progress of anatomy, he will allow, that since the time of Aristotle to the present day, there have been only *two great discoveries* with regard to the physiology of our bodies; to wit, the VASCULAR SYSTEM, and the ABSORBENT SYSTEM, the BRAIN and NERVOUS SYSTEM having been long before known. Vide Dr. Hunter's Second Lecture.

stomachs animals so totally digested, *before their form is destroyed*, that their very *bones* are made *soft*. One may indeed draw very plausible inferences concerning human digestion, from observation on other species of animals, especially from birds of prey, the cat and dog, which resemble us so much in the structure of the stomach. But analogical arguments are *probable* indeed, but not *conclusive.* And it is an object of much higher importance to attain *certainty* in man than in animals. In the writings of ancient and modern physicians no topic is more frequently discussed, yet there is little else beside *supposition:* direct experiments upon *man* are entirely wanting, and their researches are illuminated only by the *twilight* of conjecture, and supported by *precarious hypothesis.* Upon reflection, says Spallanzani, it appeared that direct experiments might be made on man, and for this purpose it was necessary to swallow tubes full of various vegetable and animal substances, in order clearly to ascertain *the changes* they undergo in the stomach. I will candidly own, says he, that the experiment gave me at first some apprehension. The histories of indigestible substances occasioning troublesome symptoms, and being vomited up after a considerable time *, occurred to my imagination. I also recollected instances where such bodies had stopped in the alimentary canal.

Dr. Coe, in his Treatise on Biliary Concretions, gives an instance of a woman, from whose rectum was extracted a concretion, the nucleus of which was a *plum stone.* In the Edinburgh Medical Essays, we have an account of a similar fact. In the Essays and Observations, Physical and Literary, there is the history of a boy who had three stones extracted from the rectum, the nuclei of which were the small bones of *sheep's trotters.* In the Philosophical Transactions, we have an account of a concretion formed upon a *plum-stone*. and retained in the blind gut: and in the London Medical Journal, Mr. Johnson relates the case of a woman, who passed a ball of hardened fæces, weighing three quarters of an ounce, the nucleus of which was a *plum-stone*.

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* Vide Baron Haller, T. 6.

Other facts however, where the result was contrary, and of more frequent occurrence, gave me also some confidence. Thus we every day see the stones of cherries, medlars, plums, &c. swallowed and voided with impunity. This consideration at last determined me to make the trial with as great caution as possible.

I swallowed, in the morning fasting, a linen bag, containing 52 grains of *masticated bread.* I retained the purse 23 hours without experiencing the smallest inconvenience, and then voided it quite *empty.* The string used for sewing and tying it was entire, nor was there any rent in the bag itself. The fortunate result of this experiment gave me great encouragement to undertake others.

From *vegetable* I proceeded to *animal* substances. In a similar bag 60 grains of *boiled veal* were enclosed, previously masticated. The purse was voided in 18 hours and three quarters, and the flesh was *consumed.* Only a few fibres remained, and these were void of succulency, as if they had been set under a press.

My next experiments were made to see, whether digestion was accomplished or aided by a *triturating power* in the stomach.

Boerhaave, neither satisfied with the system of digestion in the human stomach by heat, as suggested by Galen, and adopted by his followers; nor yet better pleased with attributing this process to the vital energy of the soul residing in the stomach, as conceived by the fertile imagination of Van Helmont; invented a system of his own, in which he attributes the digestion of our food partly to *fermentation*, but principally to *triture*, *pressure*, and *powerful quassation*. He describes the folds of the stomach as grinding the more solid parts of the aliment; and, to assist in this process, he calls in the aid of its external coat, with the diaphragm, and the numerous muscles of the abdomen. Not satisfied with these, he takes into his account the violent pulsations of the subjacent aorta, with the vibrations of innumerable surrounding arteries, which he estimates at no less than three thousand six hundred pulsations in the hour.

This distinguished physician reasoned from analogy, and took particular notice of the *ostrich*, which he had observed to swallow pieces of iron and of glass, evidently for the purpose of triture, because the sound of *grinding* was perceptible to those who listened.

In the *granivorous birds* he had remarked, beside the crop, furnished with salivary glands to mollify their food, a gizzard, or second stomach, provided with strong muscles to *triturate* the grain; and the avidity with which they swallow gravel to assist the operation had not escaped his notice. Having examined the structure of the *lobster*, he saw at the mouth of the stomach a curious mechanism, *three teeth*, of which *one* moved by a strong muscle, *triturates* the food against *the other two*.

In the larger *crawfish* of the sea, he might have noticed a structure somewhat different, where to answer the same intentions, instead of *three teeth*, we observe a *pestle* supplied with a strong muscle and placed between *two mortars*.

No wonder, then, that this great mechanic on the subject of digestion had mechanical ideas.

To prove that digestion in the human stomach is not performed by *triture*, I was under the necessity, says Spallanzani, of swallowing thin tubes. These tubes were voided in about 22 hours. Among the tubes employed in these experiments I procured some to be made so *thin* that the slightest pressure would have crushed them to pieces, or have bent in their *edges*; but though I frequently used them, *not one was ever broken*, nor on examination could I perceive the *smallest fissure.*

Having thus established this fundamental proposition, viz. *that digestion is produced by the gastric fluid independently of trituration*, I had before me, says he, a fine field for experiments, which could not fail to suggest some important truths.

The necessity of mastication deserves to be well known. There is, perhaps, no person who has not some time or other been subject to indigestion for want of having chewed sufficiently his food. I took *two* pieces from a pigeon's heart, each weighing *forty-five* grains, and having *chewed one* as much as I used to chew my food, enclosed them in two spheres, and swallowed them at the same time. Both these tubes happened to be voided at the same time, and then I saw *how much digestion is promoted by mastication.* Of the *masticated flesh* there *remained only* 4 *grains*, whereas of *the other* there were 18 *left.* This was confirmed by two other experiments, one made with *mutton*, the other with veal. The reason of this is obvious. Not to mention the saliva which moistens and attenuates the food, it cannot be doubted, that when it is reduced to pieces by the action of the teeth, the *gastric juice* meets it at all points, and therefore the more speedily dissolves it, just as other menstrua dissolve soonest those bodies that have been previously broken into fragments.

I now wished to make some experiments with the gastric fluid *out of the body.* A sufficient quantity could not be obtained by killing birds and other animals, and it became necessary to invent a contrivance for obtaining it from them alive. Three tubes containing *spunge* were therefore introduced into the stomach of a crow, and after four hours these were vomited up. The pieces of spunge being saturated with the fluids of that cavity, were then taken out and pressed between the fingers. These afforded 37 grains of *gastric liquor* of a transparent yellow colour, possessing a somewhat bitter and saltish taste.

I now attempted, says the Abbè, to produce *artificial digestion* with the gastric juice thus obtained.

It was January, and Fahrenheit's thermometer, placed near the vessel used for the experiment, stood at 42 and 43 degrees. For greater certainty in these experiments, I established a term of comparison, by employing similar vessels, containing the sàme flesh, infused in water. I also took care, upon the present occasion, that the flesh should be completely immersed in their respective liquors, and that the phials should be closed with stopples. *For seven days the flesh kept in the gastric juice, and in water continued the same.* On the eighth I perceived, says Spallanzani, a slight solution, for upon agitating both liquors, several particles separated from the larger mass, and fell down to the bottom of the phials. No further progress was afterwards made, and the gastric fluid did not seem at all more efficacious than common water; only the flesh immersed in the former *in a surprising manner was preserved from putrefaction.* In this experiment I had used beef; I verified the same observation upon the more tender flesh of calves, chickens, and pigeons; the temperature of air was about 48 degrees of Fahrenheit's thermometer.—While I was making these experiments in the natural temperature of the air, I was employed about others of a like nature in a *warmer medium*, viz. in a stove, in which the heat varied from 79 degrees to 80 of heat. *And now the effects pro-*

*duced by the gastric fluid, greatly differed from those produced by water**. In the latter the flesh began to be a little dissolved in two days; this was the effect of incipient putrefaction from heat and moisture. The *fœtid smell* continued to increase during the following day, and in a week became intolerable, when the flesh was reduced to a nauseous pulp. *In the gastric juice the solution was more rapid, and exhibited very different phœnomena; twenty-five hours were sufficient to decompose the flesh contained in it, and in a little more than two days there remained only a very small morsel entire.* These solutions never emitted any *bad smell*; whence it is evident, that they did not arise from incipient putrefaction, like those in water, but from a more efficacious and a different menstruum, viz. the *gastric liquor.*

To Edinburgh there came by accident a hussar, a man of weak understanding, who gained a miserable livelihood by swallowing pebble-stones, and chewing flints †, for the amusement of the common people. The stomach of the *stone-eater*, as he chose to style himself, was so much distended, that he was able to swallow a great number of pebble-stones during the day; and these might be plainly felt, and be *chinked*, if you pressed forcibly with your hand below the short ribs on the left side.

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* This shews how much digestion depends upon *animal heat,* and as this arises from the *oxygenation of the blood,* the relationships are concatenated. Vide Sect. XXX. *on the balance between digestion and the oxygenation of the blood.*

† His front teeth were *filed down,* and he had the art of splitting into pieces *flint stones,* by striking them with his fore-teeth in a *particular direction,* just as they fashion *flints* for guns. *These pieces* he would shew to his astonished visitants, put them under his tongue, and pretending to have swallowed them, he would then proceed actually to gulp down some *smooth pebble-stones,* which he took care to have by him on the table.

Dr. Stevens tried many experiments similar to those above related, with this man, who swallowed silver spheres, which were perforated so fine as hardly to admit a needle into each opening, and he always found the food that he inclosed in these bodies dissolved. He next turned his attention to the different degrees of *solubility*; or, as it was formerly called, to the *hard* or *easy digestion* of *different substances*, and the result of his experiments are equally curious as important.

Having procured a whelp five months old, it was kept fasting sixteen hours, and four of the globes, as used in the foregoing experiments, each containing a like quantity of food, were forced into its stomach. The substances had been previously cooked, and weighed each 16 *grains*. Seven hours afterwards the animal was killed, and the globes were taken out of the stomach; when the *beef* was found to have lost 10½ grains, the *mutton* 6 grains, the *potatoe* 5 grains, the *fowl* 4 grains, and the *parsnep* 0.

To another dog that had fasted twelve hours I gave, says he, 16 grains of *roasted beef*, in a second sphere the same quantity of veal, in a third only *fat*, and in a fourth *wheaten bread*. In ten hours the animal was killed and opened, and the tubes were taken out of its stomach. The *beef* and *bread* were quite dissolved; the *veal* had lost only ten grains, and the *fat* 8 ½ grains.

As in the last experiment the *veal* was not so soon dissolved as the *beef*, I began, says he, to suspect that the flesh of *young animals* in general is less easy to digest than *that of old ones*. I therefore took care to repeat the experiment with *lamb* and *mutton*, which were put in equal quantities into two tubes. The result was as before. In seven hours the *mutton* was *quite dissolved*, whereas the *lamb* had lost only 10 grains.

Having kept a dog fasting eighteen hours, that his stomach might be free from the remains of food, I killed it, and collected about half an ounce of pure gastric fluid, which was put in separate phials. I then made trial of *mutton, veal, lamb, chicken,* and other *animal* and *vegetable substances,* and imitating the heat of the stomach, they were all readily dissolved; but the time requisite for the completion of this process was different, and answered exactly *to the results of the preceding experiments**.

Mr. Belcher happening to dine at a callico printer's, was surprised to find the bones of the pork at table of a very red appearance. They had eat *madder.* This eminent surgeon mixed that substance with different foods, and gave it to fowls, and other animals, and a similar change of colour in all the bones, and even in the teeth, took place: but, after a certain time, if these were fed on food containing no *madder,* the bones *regained* their natural appearance. To prove that the different parts of the body are renewed, John Hunter fed two ducks, the one with *barley,* the other with *sprats,* for about a month, and killed both at the same time, When they were dressed and served at his table, that fed wholly with *sprats* was *hardly eatable,* it *tasted so strongly of fish.* These facts prove, that our fabric is ever being pulled to pieces and renewed ; that the matter is continually changed, though the same *identity* remains! They also prove that our body may be composed of parts *unassimilated,* though *changed* by the wonder-working powers of the body from *inanimate* to *animate matter!*

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* We are apt to imagine, that *hard* substances are more difficultly dissolved than *soft;* but a little attention shews us that *the menstruum* being adapted to the subject, *hardness has nothing to do in it: oil of vitriol* dissolves *steel,* and yet does not touch *wax,* and *oil* dissolves *wax,* and does not touch *iron;* and so in a thousand instances. Nurses call *lamb* harmless, only from the nature of the animal.—Dr. SHEBBEARE.

The *husk* of the seeds of plants appears to be indigestible in its natural state; whether this arises, says the celebrated John Hunter, from the *nature of the husk* itself, or from its *compactness**, I am not certain, but am inclined to *suppose the last*; as we find the *cocoa*, which is only a husk, to be digestible, when ground to a powder and well boiled. We know, likewise, that cuticle, horn, and bone, although animal substances, are not affected, in the first instance, by the gastric juice; yet if reduced in Papin's digester† to a jelly, that jelly can be acted upon in the stomach; we must therefore suppose that a certain natural degree of solidity in animal and vegetable substances render them indigestible. This compactness in the husk seems to be intended to preserve, while under ground, the farinaceous part of the seed, in which the living principle is placed; the husk having probably no other power of resisting putrefacation than what arises from its texture. Of twenty-five ripe grapes, which Spallanzani swallowed, by way of experiment, eighteen were voided *entire*, of the other seven the *skins* only appeared. He made the same experiments with cherries, and currants, as well ripe as unripe, and by far the greater number were voided *entire.* Although most husks are not capable of being dissolved in the gastric juice, they generally allow of transudation : and that the seed is in some degree affected, is known by its swelling in the stomach; yet it can only admit by that means a certain portion of the gastric juice, and that not sufficient to convert it into chyle; therefore we see grain when swallowed whole, unless in birds, whose gizzards serve them as our teeth, to grind or divide the grain, pass entire, though much swelled; and even the kernels of some nuts, as *Spanish chesnuts,* are not digestible when eaten raw.

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* This doubt, the author of the present work would have answered himself by experiment, but having himself felt the tortures of pain, he could not bear to inflict death on any animal incapable of doing him an injury from its nature, unless where the importance of the subject had justified, or rather had demanded, the cruelty.

† The advantage of Papin's digester is to give *boiling water* a greater heat than it is capable of naturally having. To do this, the vapour must not be suffered to escape. The lid is so contrived as to open inwards, that the steam may not force its way out. There is a stopple, however, on the lid, to which is fixed the arm of a lever, suspended on a balance. Weights are applied at the end nearest the stopple. Now when the water within is so very much heated, that the steam *will* force open the stopple, and so raise up the arm of the lever; by knowing what weight is suspended, we can determine exactly the degree of heat. Vide what was before said on the cooling effects of *evaporation*, or the quantity of *caloric* that escapes when water is *aerialized* or converted into *steam*.

But not only *very compact substances* are difficult of digestion, but also those that are *fluid* are so likewise: and we may observe, that Nature has given us very few fluids as articles of food, and to render the few fitter for the digestive powers, a *coagulating principle* is provided to give them some degree of solidity*.

SECTION XXX.

ON THE BALANCE BETWIXT DIGESTION AND THE OXYGENATION OF THE BLOOD.

It is impossible, says the author of the *Medical Spectator,* indeed, to peruse the following extract from a late publication of Dr. Beddoes without feeling the warmest approbation, and the most anxious desire to co-operate with him and Drs. Darwin, Ewart, Thornton, and those other physicians whose letters he has published, in their laudable attempts to render the PNEUMATIC CHEMISTRY *useful to mankind.*—These, I am well persuaded, must be the sentiments of *every medical man, who possesses a ray of true science*; and *to me*, it is particularly pleasing, because I also have many years ago entertained an opinion nearly similar. "A firm persuasion," says Dr. Beddoes, "had long settled on my mind, *that the system might be as* "*powerfully and as variously effected by means of the lungs* "*as of the stomach. And the more knowledge we have ac-* "*quired of the properties of elastic fluids, the more has* "*this my opinion been confirmed. Of all the functions,* "RESPIRATION *is, I think, the best understood*; *and it* "*will also be found in philosophic and cautious hands to be* "*the most easily managed. It is impossible,*" adds Dr. Beddoes, "*now to doubt, that we are nourished by the* "*lungs as truly, as by the stomach*; *and that what we take* "*in at the former entrance becomes, like our food, a part* "*of the substance of our solids as well as our fluids.—By* "*the lungs we can also introduce effectual alteratives of the* "*blood, and by consequence act on all the parts nourished* "*by the blood. For some time,*" adds this illustrious philosopher, "*I breathed oxygen air, with a certain portion* "*of atmospheric air, and I felt at the time of inspiration,* "*that agreeable glow and lightness of the chest, which has* "*been described by Dr. Priestley and others. In a very* "*short time I perceived a genial warmth, and a greater* "*flow of spirits than usual, and by degrees my complexion* "*from an uniform brown became fairer and somewhat florid*; "*I perceived also a carnation tint at the ends of my fingers,* "*and my lips became of a bright red. I even think it pro-*

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* All milk turns in the stomach into curds and whey. The property of calves *rennet* is well known. When too much *acidity* prevails in the stomach, a little *magnesia* corrects it, and prevents the curd from being *too hard,* and consequently difficult of digestion. It is often proper to dilute milk, in order that the *coagula* may be broken into very small fragments.

" *bable that* OXYGEN, *or* VITAL AIR, *which, by uniting* " *with the blood, creates such a beautiful colour to the com*- " *plexion, may supersede all other cosmetics*; *one decisive* " *advantage it will certainly have over them all, for while it* " *improves the looks, it will, if rightly administered,* " *amend the health also**." This experiment points out, in the strongest point of view, that *oxygen* or *vital air*, by blending with the *blood*, becomes one of the CONSTITUENT PRINCIPLES of the body.

I have had, says the celebrated Spanish traveller the Rev. Mr. Townsend, frequent opportunities of remarking a beautiful balance betwixt RESPIRATION and DIGESTION.

During a putrid fever which attacked him last summer, it was too evident to escape the observation even of his *nurses. When the stomach was oppressed, respiration laboured*; *and when the lungs were plentifully supplied with vital air, the breathing became easy, and the superabundant quantity of food was no longer a burthen.*

Mr Townsend's words are†, " whenever the air of my " bed-chamber was artificially *oxygenated*, as my physician " Dr. Thornton often witnessed, *my respiration was plea*- " *sant, my oppression at my chest relieved, and I was ena*- " *bled to breathe freely through the nostrils without the* " *assistance of my mouth, which I could not do before the* " *room was oxygenated.* At the same time I am con- " vinced *that my appetite was greatly increased, and my* " *digestion considerably quickened.*"

The celebrated Dr. Ingenhousz observes, that the air at Vienna contains more OXYGEN than in the low country of

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* From Dr. Beddoes's Letter to Dr. Darwin, on the New Method of curing Pulmonary Disorders.

† Vide *Elements of Therapeutics.*

Holland; *hence the increase of appetite of those who go from Holland to Vienna, and the reverse effect with travellers to Holland.*

When Dr. Beddoes inhaled the *vital air*, his appetite was so far increased, that he says, "that although before "he could eat only a certain quantity and was full, he "now eat double that quantity, and yet did not feel him-"self satiated."

Every one must have experienced the difference of appetite after walking in a clear air, or when staying at home.

Certain foods increase the attractive power of blood for *oxygen*. Dr. Withering, writing to Dr. Beddoes, says, the experiments you wish for have been in part made. The late ingenious Mr. Spalding, who did so much in improving and using the diving-bell, and had practised with the greatest success for many years, was a man of nice observation, and had he not fallen a sacrifice to the negligence of drunken attendants*, would have thrown much additional light upon more than one branch of science. He particularly informed me, "*that when he had eaten animal food,* "*or drank fermented liquors, he consumed the air in the* "*bell much faster than when he lived upon vegetable food* "*and drank only water.*" Many repeated trials had so convinced him of this, that he constantly abstained from the *former diet* whilst engaged in diving.

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* Mr. Spalding twice went down, accompanied by a young man, who was educated by him, to view the wreck of the Imperial East-Indiaman on the coast of Ireland. On descending the third time, in June 1783, they remained above an hour under water, and had barrels of air sent down to them, but not sufficient for their wants, probably from the drunkenness of their attendants, hence they were both found dead in the bell. This unhappy event, says the celebrated Dr. Darwin, may for a time check the ardour of adventurers in traversing the bottom of the ocean, but it is probable in another half century it may be as safe to travel *under* the ocean, as *over* it, since Dr. Priestley's discovery of procuring *vital air* in the greatest abundance from the calces of metals, as well as nitre.

We now see the reason why men who are oppressed with food, more especially animal food, *pant*; and why in a close room, where they are confined within the curtains of a bed, where the air is vitiated by passing frequently through their lungs, they open their mouths wide to breathe, and therefore why they *snore.*

I have often had opportunity to converse with miners in Cornwall, Mr. Townsend relates, who had been almost deprived of life by breathing a mephitic air, and have been informed by them, that on reviving they have constantly been seized with *nausea,* and that commonly the stomach has rejected its contents quite *crude.*

Whenever the imperfect tribe of animals, or such as sleep out the winter, are exposed to a cold so great as, in a great measure, to rob them of their *inbred heat,* their powers of *motion* are proportionably diminished, and as they cannot have, at that season, a very copious generation of caloric, but only enough to keep up the spark of life (their animal oil, which is composed of principles attractive of *oxygen,* being sufficient for that purpose), they lose all the power of *digestion.*

At Bellisle, in the beginning of the winter 1761, I conveyed, says John Hunter, worms, and pieces of meat, down the throats of lizards when they were going into winter quarters, keeping them afterwards in a cool place. On opening them at different periods, I always found the substances which I had introduced entire, and without *any the least alteration.*

A hedge-hog, while the heat of the body was at 30 degrees, had neither *desire for food* nor power of *digesting it*; but when by artificial means it was increased to 93 degrees, the animal seized a toad which happened to be in the room; and upon being offered some bread and milk, it immediately eat it. The heat roused up the actions of the animal œconomy; the breathing became quickened; and the blood, having imbibed a greater quantity of OXYGEN AIR, containing latent fire, to be extricated by the principles separated by the stomach; hence the immediate call on the *digestive powers* of that organ.

SECTION XXXI.

ON FOOD.

1. OF THE FOOD PROPER FOR CHILDREN.

NATURE not only points out the food fit for infancy, but also kindly prepares it. When the babe, soon after it is born in this *cold* world, is applied to its mother's bosom, its sense of perceiving *warmth* is first agreeably affected; next its sense of *smell* * is delighted with the odour of the milk; then its *taste* is gratified by the flavour of it; afterwards the appetites of *hunger* and of *thirst* afford pleasure by the possession of their objects, and by the subsequent digestion of the aliment; and lastly, the sense of *touch* is delighted by the softness and smoothness of the milky fountain, which the innocent embraces with its hands, presses with its lips, and watches with its eyes. Satisfied, it smiles at the enjoyment of such a variety of pleasures. It feels an animal attraction, which is love; a sensation, when the object is present, a desire, when it is absent; which constitutes the purest source of human felicity, the cordial drop in the otherwise vapid cup of life, and which overpays the fond mother for all her solicitudes and care.

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* Any one may observe this when very young infants are about to suck; for at those early periods of life, the perfume of the milk affects the organ of smell, much more powerfully than after the repeated habits of smelling has enured to odours of common strength, and the lacrymal sack empties itself into the nostrils, and an increase of tears is poured into the eyes. — And in our adult years, the stronger smells, though they are at the same time agreeable to us, as of volatile spirits, continue to produce an increased secretion of tears.—Dr. DARWIN.

A calf discovers its mother by its sense of smell; and each pig has its peculiar teat to which it always goes. What is very remarkable, when a lamb dies, to make the ewe take to another lamb, it must be covered for a few days with the fleece of the dead one.

It appears from the annual registers of the dead, that almost one half of the children born in Great Britain of great families die in their infancy. To many, indeed, this may appear a natural evil; but on due examination, it will be found to be one of our own creating. Were the deaths of infants a natural evil, other animals would be as liable to die young as man, but this we find, is by no means the case.

A mother who abandons the fruit of her womb, as soon as it is born, to the sole care of a hireling, hardly deserves that tender appellation. Nothing can be so preposterous as a mother who thinks it below her to take care of her own child. If we search nature throughout, we cannot find a parallel to this. Every other animal is the nurse of its own offspring, and they thrive accordingly. Were the brutes to bring up their young by *proxy*, they would share the same fate with those of the human species.

Connubial fair! whom no fond transport warms
To lull your infant in maternal arms;
Who, bless'd in vain with tumid bosom, hear
His tender wailing with unfeeling ear;
The soothing kiss and milky rill deny
To the sweet pouting lip, and glistening eye!—
Ah! what avails the cradle's damask roof,
The eider bolster, and embroider'd woof!—

wley Delt

J. Caldwall Sculpt

A HIRELING.

London, Pub. by Sherwood, Neely & Jones, 1813

Oft hears the gilded coach, unpity'd 'plains,
And many a tear the tassel'd cushion stains!
No voice so sweet attunes *his cares* to rest,
So soft no pillow, as his *mother's* breast! —
Darwin.

A child, soon after the birth, shews an inclination to suck; and there is no reason why it should not be gratified. It is true, the mother's milk does not always come immediately after the birth; but this is the way to bring it*: besides, the *first milk* that the child can squeeze out of the breast answers the purpose of *cleansing*, better than all the drugs in the apothecary's shop, and at the same time prevents inflammations of the breast, fevers, and other dangerous diseases, from the suppression of this natural secretion. It is strange how people came to think that the first thing given to a child should be *drugs*. This is beginning with medicine by times, and no wonder that they generally end with it. It sometimes happens, indeed, that a child does not discharge the *meconium* so soon as might be wished; this has induced physicians, in such cases, to give something of an opening nature to cleanse the first passages. Midwives have improved upon this hint, and never fail to give syrups, oils, &c. &c. whether they be necessary or not. Cramming an infant with such *indigestible stuff*, as soon as it is born, can hardly fail to make it sick, and bring on a real occasion for medicines.

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* An infant, although for some time it has no great need for food, yet doubtless ought to be laid to the breast, as soon as the mother may, by sleep or otherwise, be sufficiently refreshed to undergo the little fatigue that an attempt to suckle may occasion. This method, however unusual with some, is most agreeable to nature. By means of putting the child *early* to the breast, especially the first time of suckling, the nipple will be formed, and the milk gradually brought on. Hence much pain, and its consequences, will be prevented, as well as the frequency of sore nipples, which, in a first lying-in, have been wont to occasion no small inconvenience. To teach the child how to suck, a little milk and water, sweetened with white sugar, may be given it at the end of a tea-spoon, which the innocent will clasp in its mouth; or a finger wetted with it may be frequently put between its gums.——Dr. Armstrong, *Physician to the British Lying-in Hospital.*

Almost as soon as the babe is born the *officious nurse*, knowing what is comfortable to herself, imagines that what is good for her, and her mistress, cannot be bad for the poor infant. This naturally suggests the idea of cordials. Accordingly wine is universally mixed by nurses with the first food of children, or Dalby's carminative is administered. Nothing can be more fallacious than this mode of reasoning, or more hurtful than the conduct founded on it. Children need very little food for some time after their birth, and what they receive should be light and of a cooling quality; a small quantity of *wine* hurries on the *respiration*, and consequently the *circulation*, which nature for wise purposes has made already very *rapid**.

If the mother or the nurse has enough of *milk*, the child will need no other food. Milk itself is produced from food taken in by the mother. It is in her stomach that the aliment is dissolved, or digested, which by a combination of powers in the *chylopoietic viscera*, or parts preparing the chyle, is so far animalized † as to be converted into a kind of white blood. Hence it is very apparent, that previous to an infant having acquired strength enough to convert solid food into bland and wholesome chyle, and while the fibres of the stomach and intestines are peculiarly *irritable*, the parent, by a wise substitution in nature, has previously accomplished this work for the infant she is about to nourish.

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* In a *new born infant* the pulse is about 134 in a minute, in *middle age* from 60 to 80, and in *extreme old age* from 50 to 24.—Dr. ADAIR.

† We may observe the hen hunting after *worms* and *little insects* for its young; and poulterers follow without the bias of theory the same method of rearing them. Reaumur gave several ducks, the one *animal*, and the other *vegetable* food, and having killed them, he found the animal substances *always* sooner digested than the grain. Thus then it seems, that ANIMAL FOOD is much easier digested and transmuted in children into *animal substance*, by the powers of digestion, than the vegetable; and this plainly appears, if you begin from the first moment of the fœtus increasing in the womb, where, till its coming into light, it is formed entirely of animal substance.

After the second or third month, it may then be proper to give the child, once or twice a day, a little of some other food*. This will ease the mother, will accustom the child by degrees to take food, and will render after weaning both less difficult and less dangerous. Nature abhors all sudden transitions. For this purpose, the food of children ought not only to be simple, but to resemble, as nearly as possible, the properties of milk. Indeed *milk* should make a principal part of their food, not only before they are weaned, but for a long time after.

Bread may be given to a child as soon as it shews an inclination to chew. The very chewing of bread will promote the cutting of the teeth, and the discharge of saliva. Children discover an early inclination to chew whatever is put into their hands. Parents observe the *inclination*, but know not how to apply the *remedy*. Instead of giving to the child something which may at once exercise its gums and afford it nourishment, they commonly put into its hands a piece of hard metal, or impenetrable coral. A crust of bread, or a piece of stick liquorice, is the best *suck-thumb*. It not only answers the purpose better than any thing else, but has the additional properties of nourishing the child, and carrying the saliva down the stomach, which is a great promoter of digestion.

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* As *soft biscuit* or *crust of bread*, which are easier digested than *crumb*, with *milk* and *water*.

It is soon enough to allow children *animal food,* when they have got teeth to tear it. Then we should remember that their pulse is usually at 130, and from the observation of Mr. Townsend and others, the pulse is quickened by *animal food,* and the same is not observed, when we have been eating only *vegetables**. We should then employ a plentiful mixture of vegetable with their animal food, which, as the proper food of manhood, the formation of his *teeth* † naturally points out to the physiologists, and the experience of ages has proved to be the most conducive to health. As the stomachs of children cannot bear repletion, because of their temperament, and as they require food not only to keep up the parts already formed, but also to make an addition to them, they ought therefore to have *slender* but *frequent* meals, and this in proportion to their tender age.

11. OF THE FOOD PROPER FOR MANHOOD.

It is an ancient and approved maxim, that a life guided entirely according to the directions of art, must be a miserable one; and the most judicious practitioners, sensible of the justness of the observation, and that what is prohibited is often the more eagerly coveted, have endeavoured, even to persons labouring under disease, to give as great latitude as possible in the articles of diet, and to reconcile every part of the regimen they prescribe, as nearly as they can, to the common mode of living, in order that the patient may be reminded as little as possible of his misfortune. Our directions therefore shall not be frivolously minute, but as short as possible on this subject.

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* Vide *Townsend's Elements of Therapeutics,* page 27.

† He has the *canine* or tearing teeth, the *incisors* or clippers, and the *grinders.* Those animals that have *only* the *canine teeth,* as the lion, &c. have a *gastric juice* that does not dissolve *vegetables;* and on the reverse, those that have only the *incisors* and *grinders,* as the horse, &c. have a *gastric juice* that *only* dissolves *vegetable substances.*

In the first place we ought carefully to *chew* our food, otherwise we shall impose much unnecessary labour on the stomach, and retard digestion.

With respect to *quantity*, it is evident that this must be regulated by our feelings. A healthy man cannot be said to exceed in the quantity of his meal, if he finishes it with a relish for more; if, immediately after eating, he can, if required, follow any employment, that does not demand strong exercise or violent exertions; which to persons in easy circumstances will rarely be necessary, and ought in general to be avoided, as it disturbs digestion*; though daily practised, from necessity, by the labouring poor †.

Gluttony is so ungentlemanlike a vice, that it would be an affront to suppose that persons of polished manners, who are the persons who will probably read this work, could be capable of it. I shall therefore forbear to mention the innumerable train of evils that in time is certain to attend this beastly practice.

With respect to the *proper times* for eating, first,

OF BREAKFAST.

As our ancestors breakfasted early, they dined also early, and had at least two meals after this, as appears from the allowance appointed for a *Lady Lucy*, who seems to have been one of the maids of honour in the court of Henry the VIIIth. I may be allowed to mention their articles of food, as a matter of curiosity, to shew in what manner the *fine ladies* lived in those days.

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* Dr. Adair.

† This has been before very *seriously* adverted to, and it is hoped that it will finally have its *due weight*, the conduct of masters being here (like the traffic in human flesh) both *cruel* and *impolitic*. Dr. Harwood, the Professor of Anatomy at Cambridge, took two pointers equally hungry, and equally well fed; the *one* he suffered to lie *quiet* after his meal, the *other* he kept for above two hours in *constant exercise*. On returning home he had them both killed. *In the stomach of the dog that was quiet and asleep, all the food was digested; but in the stomach of the other dog that process was scarcely begun.*

This lady was allowed for BREAKFAST,

a chine of beef,
a loaf, and
a gallon of ale.

We have an account also of the BREAKFAST of an *earl* and *countess* in the lent season, viz.

a loaf of bread,
2 *manchettes* (which seem to have been loaves of a coarser bread),
a quart of beer,
a quart of wine,
2 *pieces of salt fish,*
6 *baconed herrings,*
4 *white herrings*, and
a dish of sprats.

With respect to the *quality* of our different meals, we seem to depart more from the custom of our hardy ancestors with regard to *breakfast*, than any other meal. The contrast at first sight appears truly ridiculous. *A maid of honour* in the court of Queen Elizabeth, breakfasted upon *beef*, and drank *ale* after it; whilst the *sportsman*, and even the *day-labourer*, now breakfast upon *tea*.

The philosopher here humbly attempts to vindicate the present race; he believes that *sleep*, which *accumulates* the irritability of the fibre, disposing it to be more readily affected by stimuli of all kinds, hence the violent effects of all cordials taken in the morning, and hence perhaps the propriety of the gently stimulating power of coffee or bohea tea*. He would also recommend here *bread* moulded into such shapes as to produce a great deal of crust†, and he would recal the reader, who reckons health as the first blessing, and as the means of enjoying and heightening all other blessings, to reflect on the utility of the *saliva,* and to remember that bread when buttered absorbs little or no saliva, while a pound of dry bread carries down with it the same weight of this necessary moisture‡. We would here, therefore only caution the reader against taking his tea *too hot,* and if he has been engaged throughout the preceding day, or that morning, in much exercise, to join with this necessary meal one or two soft *boiled eggs* §.

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* TEA, whether *green* or *bohea,* is thought to be, though I doubt it, the produce of the *same* plant, the *green tea* being the shoots and earlier leaves, and *bohea* those more *advanced* and *expanded.* Like other stimuli, *green tea* made very strong is an *emetic,* or occasions *tremors;* if moderately strong it *agreeably refreshes* after a fatiguing journey, and from its excitement is productive of *wakefulness* to habits unaccustomed to *that stimulus.* GREEN TEA is suited *only* to *old age,* and *cold unirritable habits.*

† We saw before that *solid substances* are easier acted upon than *glutinous.* Thus *hot water* sooner dissolves *white sugar* than *soft gum,* and *aqua fortis* corrodes copper, though it does not touch *wax.* It is less subject to *ascescency,* and does not swell in the stomach.

‡ Pieces of meat, that may happen to get between the teeth, are *dissolved* by this menstruum, or at any rate are so *softened,* and *their texture broken,* that this inconvenience is speedily removed. If not a fluid, possessing properties the same as the *gastric fluid,* it must be allowed, certainly, that it *greatly aids that solvent.* If this penance be too great for the middle period of life, and muffins and crumplets soaking in butter must be indulged in, *children,* however, may be prohibited *butter,* and be made to have *good constitutions,* by which the contagion of *bad example* will afterwards be less severely felt.

§ This custom universally prevails in *Ireland,* and is better than *hung-beef* and *anchovies,,* which accompany the *Scotch* breakfast.

OF DINNER.

The *same lady* who had *so solid a breakfast*, had for DINNER,

a piece of boiled beef,
a slice of roasted meat, and
a gallon of ale.

IN THE AFTERNOON,

a manchette, and
half a gallon of ale.

FOR SUPPER,

a mess of porridge,
a piece of mutton,
a cheat (or finer loaf),
and a gallon of ale.

To be sociable after supper, there was left on the table,

a manchette loaf,
a gallon of ale, and
half a gallon of wine.

This lady had therefore four *heavy meals*. Instead of this we are led to recommend the modern practice of late dinners.—But because long fasting is injurious, and when very hungry we may be induced to eat more at this principal meal than can be properly digested, we would recommend *cold meats or soups* by way of COLLATION.

For dinner we would advise those, who have a due sense of the importance of health, to keep as much as possible to *one dish*. To prefer MUTTON* to lamb, LAMB to *chicken* or *veal*, and BEEF, if tender, to either of the *three* last, and as *fish* is soon digested, to unite some *flesh meat* with it, and to add to these *vegetables*. Could I believe I should be listened to with indulgence, and not incur the general censure of prejudice, having nothing but *philanthropy* and the *improvement of science* for my object, I would condemn, for convalescent and weak persons, those heterogeneous combinations called *puddings*†, and am inclined to condemn also, though not the fruit, yet the *crust* of *all pies.* Let my readers here call to mind, that eggs and milk are both reckoned wholesome *separate*, but when combined, form a compound suited only for *strong stomachs.*

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* When Sanctorius eat MUTTON, which was a food peculiarly grateful to his stomach, his *feelings* were *pleasant*, and his *perspiration* was *copious*;—when he eat *pork*, *goose*, *duck*, *mushrooms*, or *melons*, he was *heavy* and

The art of cookery I am inclined to compare with the diabolical art of *undermining a town*. We all avoid the *red poison berries*, and caution others against them, though we give our FRIENDS *poisoned pickles, and preserves made in copper saucepans*, &c. and hold out such temptations to *over-gorging*, which weak minds cannot resist.

> ——————————— They dine
> With dishes tortur'd from their native taste,
> And mad variety, to spur beyond
> Its wiser will the jaded appetite!
> *Is this for pleasure?*—Learn a juster taste;
> And know, that TEMPERANCE is TRUE LUXURY.
> *Or is it pride?*—Pursue some nobler aim.
> Dismiss your parasites, who praise for hire;
> And earn the fair esteem of honest men,
> Whose praise is fame. Formed of such clay as yours,
> The sick, the needy, shiver at your gates.
> Even modest want may bless your hand unseen,

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oppressed; and found by the balance, that *his perspiration diminished one half*. This proves that even the *perspiratory discharge* is very much under the influence of the STOMACH.

† Very few exceptions to this rule. The plainest puddings are generally very *compound*.

Though hush'd in patient wretchedness at home.
Is there no virgin, graced with every charm
But that which binds the mercenary vow?
No youth of genius, whose neglected worth
Unfoster'd sickens in the barren shade?
No worthy man, by fortune's random blows,
Or by a heart too generous and humane,
Constrain'd to leave his happy natal seat?
There are, while human miseries abound,
A thousand ways to waste superfluous wealth.

Armstrong.

A foreigner was invited to a party consisting as he was told, of *English philosophers*, of whom he conceived a great deal. After a very plenteous dinner the cloth was cleared, and the bottles were placed on the table. He was pressed after five glasses to drink on; but the stranger persisted in assuring the company "*he felt no drought.*" These *philosophers* began then to be *angry*, and the foreigner rang the bell, and *insisted* on another course, for *they* ought as much to *eat* against reason and inclination, as *he* had to *drink.*

I would here recommend the excellent saying, *a glass* for *digestion*, *another* for *my relations*, a *third* for *my king*, a *fourth* for *my country*, and if a *fifth*, it must be for *my enemy.*

It will not, I think, admit of a doubt, that *beer* or *water* is the only drink necessary in *early youth*; and that *wine* and *spirituous liquors*, of which luxury has introduced a variety, ought to be appropriated solely to the *middle period*, to the comfort of *invalids*, and the invigoration of *old age.*

The great objection, however, against *geneva* and *water*, and *brandy* and *water*, is, that *invalids* are very apt to increase the proportion of the spirit ordered, and the great Dr. Fothergill, who was among the first who gave sanction to this practice, declared, some time before his death, that he repented of having done so, from the *unfortunate habit* that had *stole* on some of his patients.

On pleasure's flowery brink we idly stray,
Masters as *yet* of our returning way.
Seeing no danger—we disarm our mind,
And give our conduct to the waves and wind,
Then in the flowery mead, or verdant shade,
To wanton dalliance negligently laid,
We weave the chaplet, and we crown the bowl,
And smiling see the *nearer waters* roll,
Till the *strong gust* of *raging passions* rise,
Till the dire tempest mingles earth and skies,
And swift into the boundless ocean borne,
Our *foolish confidence* too late we mourn;
Round our devoted heads the billows beat,
And from our troubled view the lessening lands retreat.

" Struck by the powerful charm, the gloom dissolves
In empty air; *Elysium* opens round.
A *pleasing phrenzy* buoys the lighten'd soul,
And *sanguine hopes* dispel your fleeting care;
And what are difficult, and what was dire,
Yields to your *prowess* and *superior stars;*
The happiest you, of all that e'er were mad,
Or are, or shall be, could this folly last.
But *soon your heaven is gone;* a *heavier gloom*
Shuts o'er your head: and, as the thundering stream,
Swoln o'er its banks with sudden mountain rain,
Sinks from its tumult to a SILENT brook;
So, when the *frantic raptures* in your breast
Subside, you *languish* into *mortal man;*
You SLEEP,—and waking find yourself *undone.*
FOR PRODIGAL OF LIFE IN ONE RASH NIGHT
YOU LAVISH'D MORE THAN MIGHT SUPPORT THREE DAYS.
A *heavy morning* comes; your *cares* return
With tenfold rage," &c.

ARMSTRONG.

Let us consider for a moment, the stimulating or exciting power of *wine*. When a depressed man is insufficiently excited with the *natural stimuli*, and rises not, suppose, above 30 degrees in his excitement, a glass carries him up to 32 degrees, another to 34 degrees, and so forth, till after five glasses he is carried up to 40 degrees, he then finds himself well and vigorous in all his functions. But still we are not so flimsily made, as not to bear a little of what is either *too much* or *too little*. Suppose he then takes five glasses more, and consequently is raised to 50 degrees. As his spirits, his intellectual, and all his other functions, were low, while his excitement remained at 40 degrees, so are they all proportionally exalted by the time that his excitement is elevated to 50 degrees. Let him still go on, and his intellectual functions will rise still higher; he will now display the full extent of his genius; and his passions and emotions of whatever kind they be.—If he goes on, *how will the appearance be reversed!* The *hero* soon shrinks into a mere brute. He falls off in both his intellectual and corporeal functions; his tongue, his feet, his eyes, his memory, fail him; and at last, deprived of all power of motion and sense, he sinks into an inanimate SLEEP.

Spirits, says the Abbé Raynal, were the gift the most fatal the old world ever made to the new. It was soon observed, that it disturbed their domestic peace, deprived them of their judgment, and made them furious. In vain did some Frenchmen expostulate with them, and endeavour to make them ashamed of *these excesses*. "*It is you*,' answered they, "*who have taught us to drink this liquor,*
" *and we cannot do without it. You have done the mischief,*
" *and it admits of no remedy*."

To the credit of the present age, *hard drinking* is rarely practised by persons of liberal education; though, from the habit of sitting at table some hours after dinner, we are tempted to *exceed* in the quantity of wine; which even with persons in health too frequently destroys, in time, the tone of the stomach.

Were the pleasure of the palate lasting, says Cornaro, *there would be some excuse for inebriety, but it is so transitory, that there is scarce any distinguishing between the beginning and the ending*; *whereas the diseases it produces are very durable.* This fact is well known in the distilleries, where the *swine* which are fattened by the spirituous sediments of barrels, all acquire *diseased livers*.

Mark what happens to that man who drinks much wine, if he has not been habituated to so violent and exhausting a stimulus. He loses the use both of his limbs and of his understanding! He becomes a temporary idiot, and has a temporary stroke of the palsy! And though he slowly recovers after some hours, is it not reasonable to conclude, that a frequent repetition of so powerful a poison must at length permanently affect him?—If a person accidentally becomes intoxicated by eating a few mushrooms of a peculiar kind, a general alarm is excited, and he is said to be poisoned; but so familiarized are we to the intoxication from vinous spirits, that it occasions merriment rather than alarm.

The story of Prometheus seems to have been invented by physicians in those ancient times, when all things were clothed in hieroglyphic, or in fable. Prometheus was painted as stealing *fire* from heaven, which might well represent the inflammable spirit produced by fermentation; which may be said to animate or enliven the *man of clay*: whence the conquest of Bacchus, and heedless mirth and noise of his devotees.—*But the after punishment of those, who steal this accursed fire, is a vulture gnawing the liver*; *which well allegorizes the poor inebriate lingering for years under painful hepatic diseases**.

Drinking is undoubtedly the most miserable refuge from misfortune. It is the most broken of all reeds. This solace is truly short lived; when over, the spirits commonly sink as much *below* their usual tone, as they had been before raised *above* it. Hence a repetition of the dose becomes necessary, and every fresh dose makes way for another, till the miserable wretch is rendered a slave to the bottle; and at length falls a sacrifice to what, at first, perhaps, was taken only as a medicine. No man is so dejected as the drunkard when the debauch is over. Hence it is, that those who have the greatest flow of spirits while the glass circulates freely, are of all others the most hipped when sober. It may be pleasant to get drunk, but the next day is a day of uneasiness, and the third ought to be a day of repentance. To those who drink to drive away care, I would recommend the careful perusal of the following lines—

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* Dr. Darwin.

> Unhappy man, whom *sorrow* thus and *rage*,
> Two different ills, alternately engage.
> Who drinks, alas! *but to forget*,—nor sees
> That melancholy, sloth, severe disease,
> Memory confused, and interrupted thought,
> Death's harbingers, lie latent in the draught,
> And in the flowers that wreath the sparkling bowl
> Fell adders hiss, and poisonous serpents roll.
>
> PRIOR.

Let those who have been enticed frequently to taste spirituous liquors, or rich cordials, till at length they begin to have a fondness for them, reflect a moment on the danger of their situation, and resolve to make a speedy and honourable retreat. Remember, that custom soon changes into habit; that habit is a second nature more stubborn than the first, and of all things most difficult to be subdued. Remember, that it is by little unsuspecting beginnings, that this unfortunate vice is generally contracted, and when once confirmed, rarely terminates but with life! Learn then, in time, to resist this bewitching spirit, whenever it tempts you. Then will you find yourself so perfectly easy without it, as at length never to regret its absence; nay, peculiarly happy in having escaped the allurements of such a dangerous and insidious enemy.

The manner, however, of overcoming this fatal propensity, when once formed, requires some address in the physician. It is in vain to desire an immediate desertion of this habit. Human nature is too frail. It cherishes knowingly the usurper in its bosom. Art must be used. The drunkard must be advised to change his liquor, taking rum instead of brandy, and then Geneva; afterwards it must be diluted, and in time it may without much difficulty be changed for ale, or porter, and a habit broken, or else fixed upon some less hurtful liquor than spirits *.

To those who pride themselves in living fast, and are bent upon "a short and merry life;" though, in truth, it is a short and miserable one; they will doubtless spurn at these admonitions, and run headlong to their own destruction. Strange infatuation! Can you submit to such despicable bondage, and tamely give up your freedom without one generous struggle. The present conflict, remember, is not for the fading laurel, or tinselled wreath, for which others so earnestly contend, but for those more blooming, more substantial honours, which HEALTH, the daughter of TEMPERANCE, only can bestow. For it is thine, O HEALTH, and thine alone, to diffuse through the human breast that genial warmth, that serene sunshine which glows in the cheek, shines in the eye, and animates the whole frame! But if still you have no regard for this blessing, let me then remind you of an HEREAFTER.—

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* I once cured a patient of this propensity by ordering a small portion of emetic tartar to be put into the brandy bottle. This, when taken to excess, produced nausea, or vomiting; and the idea getting associated, even the sight of it became afterwards disgustful.

"To die—to sleep—nay, perchance, to dream"—yes, *there's the rub!*—How great will be your surprise and terror should you be suddenly roused by that dream!—When the thick mist is dispelled—when the day begins to dawn, and discovers you on the confines of that unknown country!—When THE SON OF RIGHTEOUSNESS——But here let me stop, for exhorting, and not preaching, is my province. To the divine it belongs to resume the subject where I am obliged to drop it, and to expatiate on those higher arguments, which, with a trembling pen, I have scarcely ventured to suggest.——

A *late dinner* gives a long morning, and precludes the necessity of a hearty supper, and tea may become its substitute, and call together, to a cheap entertainment and the pleasures of social intercourse, a meeting of cheerful friends. Abstracted from the cares of the busy day, having no variety of objects to draw off the attention, viewing the expressive and brilliant countenances of those he is in converse with, with spirits gently agitated, and cares dispelled, he returns with the partner of his choice, from the splendid circle, and wakes the next morning refreshed by a sound and tranquil sleep.

III. OF THE FOOD PROPER FOR OLD AGE.

Man is a compound of matter so organized as to be capable of being acted upon by various stimuli, necessary to the continuance of life; and immediately upon his birth the first stimulus he receives is a quantity of atmospheric air in the lungs; this, with the addition of some milk, or mild food, taken into the stomach, is all the stimulus he seems capable of bearing, at this period, consistent with life and health; the external senses cannot endure any strong action on them; hence the tympanum, or drum of the ear, is kindly covered for some time after birth with a thick mucus, occasioning deafness; and the eyes are shut against, or turn from, the impression of strong light. In this state, as was before shewn, there is the *keenest irritability*; the smallest stimulus, even that of the air of a chamber, more especially the purer and colder air abroad, and the mildest food so act upon the babe, and exhaust it, as to produce almost constant sleep.

From day to day the *irritability* of the fibre gets *diminished*, as is known to us by the circumstance of the same stimulants having a lesser effect on the fibre, in proportion as we advance from infancy to puberty, and from puberty to manhood. At this period of life, viz. about thirty-five years of age, it appears that there exists, as it were, a just equilibrium between the powers of the *ordinary stimulants* and the *irritability* in the muscular fibre; yet, at the same time, as the continued application of the ordinary stimuli is absolutely necessary to life and health, so the daily effects of these is a small degree of *exhaustion* of *irritability*, restored nearly by periodical sleep. But again, according to the organization of our bodies, though sleep restores the healthy state of *irritability* in a certain degree, yet it seems never to restore actually *the former state*; a small degree of *exhaustion* of *irritability* takes place every year. This gradual change, consequently, not only indicates the power of bearing, but also the necessity of the application of *stronger stimuli*, as we advance in life, until at last, that state takes place which we call *extreme old age*, which is little affected by the ordinary, and scarce sensible of the stronger, stimuli; hence verifying the adage, that MILK is the food of *infants*, and WINE of *old age*.

The *appetite* for food is generally increased in old age. The famous Parr, who died at 152, ate heartily in the last week of his life. The kindness of nature, in providing this last portion of earthly enjoyments for old people, deserves to be noticed. It is remarkable, that they have like children, a frequent recurrence of appetite, and sustain with great uneasiness the intervals of regular meals. The observation, therefore, made by Hippocrates, that middle-aged people are more affected by abstinence than those who are old, is not true. This might easily be proved by many appeals to the records of medicine; but old people differ from children, in preferring solid to liquid aliment. From inattention to this fact, Dr. Mead has done great mischief, by advising old people, as their teeth decayed or perished, to lessen the quantity of their solid, and to increase the quantity of their liquid food. This advice is contrary to nature and experience; and I have heard of two old persons who destroyed themselves by following it. The circulation of the blood is supported in old people chiefly by the stimulus of aliment. The action of liquids of all kinds upon the system is weak, and of short continuance, compared with the durable stimulus of solid food. There is a gradation in the action of this food upon the body. Animal matters are preferred to vegetable; the fat of meat, to the lean; and salted meat to fresh, by most old people. I have met with but few old people who retained an appetite for milk.

Take wine for thy stomach sake, is the recommendation of the Apostle Paul; but even at this period it must be taken in great moderation, for only a little intoxicates; and, as Shakspeare beautifully says,—

> O that *men* should put a thief into their brains
> To steal away their senses.

Which would be yet more disgraceful at this period of life.

SECTION XXXII.

ON SMOKING.

A PUBLIC LECTURE[*].

Gentlemen,—During the first three or four years of our medical establishment, I have frequently found it needful to give public lectures in this place. Even eight or ten years after its establishment, it was customary to commence, and to close the medical course, by a public lecture in the chapel [†]. The custom, however, has been discontinued several years, as nothing special excited a wish to address you altogether. Whether its revival, at this time, be for a trivial or beneficial purpose, you yourselves will judge.

When our venerable forefathers fixed upon this spot, as a fit place for the education of youth, they doubtless had regard to the health of its inhabitants. A gravelly plain, near the banks of a tide river, and in the proximity of the sea, together with good springs of pellucid water [‡], must have led our sagacious ancestors to conclude, that this was a salubrious spot for a college. Time has done honour to their judgment; as, during one hundred and fifty years, the town of Cambridge, and the College, have exhibited a succession of joyful instances of juvenile vigour, healthy manhood, and comfortable old age. From observations made by the late excellent Dr. Wigglesworth*, it appears, that there occurred fewer, much fewer deaths, among the collegians, than among any set of young men in any part of the Commonwealth. Since my connexion with this university as Professor, I can bear testimony to the healthiness of the inhabitants of the town in general, and of the students in particular †. I have noticed the young men within these walls with pleasure, as a blooming, cheerful, and noble assemblage of youthful activity. But does this charming picture any longer exist? Is it not faded and fading, like a flower that has passed its bloom ; and which is about to wither on its stalk ? If this idea be just, surely the cause of this faded aspect in the plants of our seminary calls loudly and affectionately for investigation. If the full bloom of exuberant health once marked and adorned these seats, and this bloom is fled, or fleeing away, it is certainly an object of prime importance to inquire whence this deterioration ? Were I not persuaded that it might be traced to a moral, as well as a physical source, I would not have appeared at this time before you. My motive is your welfare, and the happiness of your parents ; for what are riches and knowledge without health to enjoy them ? But, alas! the young, the gay, and the giddy, abuse health through ignorance ; and when better informed, some of them refuse to stop, or lend a listening ear to the warning voice of nature and common sense ; while " he that taketh heed prolongeth his life."

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[*] By Benjamin Waterhouse, M.D. Professor of the Theory and Practice of Physic, in the University of Cambridge in America.

[†] A *public* lecture means here an address to all the students of the university of every rank and class.

[‡] WATER was thought by Hippocrates to be an article so important to the health of a people, that of his treatises, one of the most elaborate is "on *air* and *water*;" which includes soil and situation. Had the builders of Jericho known and followed the rules of Hippocrates, they would not have complained to the prophet Elisha, that although "the situation of the city was pleasant, the water was naught, and the ground barren."

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* This worthy gentleman was Professor of Divinity. His death, which happened in June 1794, the author has never ceased to lament. To him we principally owe the Medical Institution, founded here in 1782. By opening a correspondence with Principal Robertson and the Medical Professors at Edinburgh, he matured the plan, and lived to see it flourish.

† Professor Pearson remarks, in a lecture published since this was delivered, that "from 1769 to 1796, a period of twenty-seven years, but nine deaths took place among the under graduates. But from 1796 to the present time, a period of little more than eight years, sixteen students terminated their probation for eternity before they had completed their academic course; and, what deserves particular notice, most of them died of consumption. During the period first mentioned, the deaths were to the years as 9 to 27, or as 1 to 3, that is, one death in three years. During the last period, the deaths have been to the years nearly as 16 to 8, that is, two deaths in one year. Hence it appears, that the number of deaths among the under graduates during the last eight years, compared with that of the preceding twenty-seven years, has increased nearly in a sixfold ratio. A result worthy of serious consideration; especially when it is added, that four of these melancholy events took place in one year, and six of them in one class. In this connection I am constrained to add, that during the two last years, and soon after receiving the first honours of this university, four others have been numbered with their deceased companions, alike victims to consumption."

It is proper to inform you, that we are led in the order of instruction to speak, at this period of our course, of those disorders which mankind bring upon themselves by their own imprudence.

It was a sagacious saying of one of the ancients, that " God sends acute diseases, but chronic disorders we create ourselves."

Acute diseases are such as proceed with rapidity, and terminate soon ; such are violent fevers, plurisies, quincies, and epidemical disorders. They are generally owing to a cause that " walketh in darkness," being such as prudence could not obviate, nor our prescience guard against. The superstitious are apt to ascribe the most dismal diseases, and most shocking accidents, to the anger of invisible beings ; thus, when the plague was desolating the Grecian camp, instead of resorting to human remedies, they had recourse, like our Indians, to incantations and inchantments.

Chronic diseases are those that come on slowly, and continue long. We place under this head, depraved appetite, jaundice*, and the long and gloomy train of nervous disorders. To these we may add, gout, asthma†, palsy, and apoplexy; as well as that imbecility or morbid derangement of the absorbent system, occasioning dropsies; which is accompanied by that generally depraved habit of body, known among physicians by the name of *cachexia*; all of which are owing to chronic weakness; the source of which is an imbecility of the digestive organs, occasioning errors in "the first concoction," which deranges the whole chain of processes occurring between chylification and sanguification.

Perfect health requires the temperate action of the vital influence through every part of the system. In perfect health, every secretion and excretion is duly performed. Perspiration is neither deficient nor excessive. The breathing is free and easy, requiring neither conscious exertion, nor even a thought. The action of the heart and arteries, with the consequent circulation of the blood is regular and placid; neither too rapid nor too indolent; neither laboured nor oppressed. In perfect health, the body continues in the exercise of its proper functions, without the least sensation of difficulty or embarrassment. The mind, undisturbed by any violent emotions, agitations, or depressions of a corporeal nature, is in a state for exercising its noblest powers with tranquil vigour. The body is perfectly free

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[*] That species of jaundice, especially, termed Icterus *mucosus*. See Van Swieten, § 950.

[†] That species denominated Asthma *flatulentum*, which, like the gout, palsy, and apoplexy, takes its origin from long continued affections of the stomach.

from pain, oppression, hebetude, and every species of uneasiness; and a certain vivacity, not to be described, reigns throughout the system*. This happy, but evanescent condition, constitutes the "*mens sana in corpore sano*" of Juvenal, " a healthy body and a mind at ease."

The first derangement of this delightful state is felt in the stomach. Its faculty of communicating impressions, made by various substances taken into it, is such, that it seems more like a nervous expansion from the brain, than a mere receptacle for digesting food. We shall speak of this faculty hereafter, and confine our view at present to the function of digestion.

Digestion is the selection and conversion of some foreign pabulum, or food into our own nature. There are within us two organs, performing at the same time two different kinds of digestion; for while the stomach is digesting solid substances, the lungs are digesting air. Digestion of solid substances by the stomach, is the conversion of food into chyle, and of chyle into blood. A regular supply of this milky fluid is necessary to recruit and repair those parts of the animal machine that are incessantly wearing down and passing off by the very actions requisite to life. When this function is impaired and much deranged, the patient languishes, becomes emaciated, faints, and at length dies. If digestion be well performed, that is, completed within three or four hours ‡, the chyle is proper, be the food ever so various. Blood formed from this chyle is natural; the secretions and excretions are regular; and health, strength, activity, and cheerfulness ensue. But if digestion languish, the contrary of this will happen, be the food whatever it may.

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* See an Essay of Dr. Cogan's, on the subject of Health.

‡ Marshal Biron, who had a remarkably keen appetite, was killed by a cannon-ball an hour after dinner. On opening the body, not the least trace of food was to be found in the stomach.

That the lungs digest air, may be to you a novel doctrine. These vital organs are made up almost entirely of two sets of vessels, one conveying air, the other blood. When we inhale atmospheric air, these organs, in the action of breathing, separate a portion of that inspired mass, called *oxygen*, or vital air, which, entering the blood, vivifies and animates the whole frame, and actually becomes one of the constituent principles of our bodies. Between this oxygenation of the blood through the lungs, and the digestion of the food by the stomach, there exists an inseparable sympathy, and a beautiful balance. When the stomach is loaded with a superabundance of food, we pant for breath. When we breathe the oxygenated air of the mountains, or of the open ocean, we feel not merely a keener appetite, but a greater quantity of food than ordinary will be digested without oppression of the stomach or labour of the lungs. In fewer words, it is oxygenation that excites the dormant energies of the brain and nervous system, which invigorates every fibre, giving strength for debility, and activity for sluggishness*. Such is the conspiration of action between the stomach and the lungs, and such the sympathy of both with the whole human system, that these organs are either primarily or secondarily affected by every malady, that flesh is heir to.

The first intimation of a chronic disorder is almost always felt in the stomach. That wonderful organ has a remarkable contractility, by which it applies the inner surface closely to the materials it incloses*. That distressing sensation, called "a sinking" at the stomach, is owing to a diminution of its power of contraction. The healthy contractility of this prime organ of digestion, is not owing merely to the force of its own fibres, but depends on the joint energy of the whole system, mental and corporeal; for the more vigorously the stomach applies itself to its contents, the more speedily is digestion performed; and the braver does a man feel, the better does he walk, think, and write.

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* Arnaldus de Villa Novo, an excellent physician, chemist, and philosopher, who flourished about the year 1300, was not ignorant of this exhilarating *something* in the atmosphere. He speaks of a clear, pure air, that makes the heart glad, the mind serene, the body lightsome, at the same time that it accelerates digestion. He speaks of a contrary condition of the air, which disturbs the heart, darkens the mind, makes the body heavy, and retards and hinders the digestion.

The disorder advancing, the patient is oppressed with listlessness and sense of weight over all his body; he becomes pale at certain intervals, and a sweat breaks out, irregularly in different parts of his body. Digestion is slow; in consequence of which, the patient is distressed with mawkishness, sourness, heart-burn, and nausea, with frequent calls for food, from a sense of sinking, not from genuine hunger. The distension of the alimentary canal by flatulency increases the distress of the sufferer. It is remarkable, that in this state of the stomach, wine is more eagerly desired than at any other time.

The causes of the disorder continuing to be applied, sleep is disturbed, and followed by torpor, bordering on stupidity; the patient's eyes become hollow, and lose their vivacity; an universal debility, most sensibly felt in the digestive organs, with an increased or morbid irritability, perverting their regular actions; the pulse is quickened, the breath labours, cough comes on, and consumption follows.

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* It can be distended so as to contain five quarts, and contracted so as to contain less than half a gill.

When the fountain of health is thus disturbed, the smallest streams must also be deranged. Can we wonder, then that the, *ultimœ vasculœ* and the *minimœ fibrillœ* of the organ of intellect are finally affected, occasioning despondency of mind, or else peevishness, doubts, fears, wandering thoughts, and ridiculous fancies? The disease seldom proceeds to this in very young persons. As imprudence in youth lays a foundation for hypochondriasis, in certain temperaments, in manhood, you cannot be too cautious of the first breaches on your tender constitutions. If in youth you transgress the first principles of nature, she may punish you in future life with a long and dismal train of nervous disorders, than which there cannot be a greater torment. A nervous man may escape volcanic eruptions, earthquakes, hurricanes, inundations, mobs, sieges, and revolutions; but whither shall he fly to avoid heats and frosts, a louring sky, and east winds? To what city or village shall he repair, that is not infested with creaking doors, jarring windows, screaming children, and fretful inmates, to lacerate his tender nerves, and render him the most wretched being under heaven?

Having given you a description of cheerful health, and of its deviation into gloomy disease, let us now see if we cannot discern some general cause, or causes, producing this declension†.

Moral philosophers unite with physicians of the first rank in opinion, that all chronic disorders arise from either, 1st. Vexation of mind; or, 2d. An indolent and sedentary life; or, 3d. Intemperance; or from the co-operation of any two of them; or from the combination of all three.

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† Ut curvi norma rectum, ita morbi sanitas, says Gaubius:—that is, as a curve line is the reverse of a strait, so is health of a disease.

It is a melancholy reflection, that there are as many pressed down to the grave by chronic disorders, brought on by a troubled mind, as are cut off by acute ones. Envy, jealousy, concealed resentment, and the corroding discontents of a life of penury and neglect, have slow, but destructive effects on the delicate mind and " fine spun frame." A man is often cheerful under the loss of a limb, and long habit may render a deranged state of health tolerable; " but a wounded spirit who can bear ?"

The first effect of violent grief or troubled mind, is deprivation of the powers of digestion. A man in the best health, the highest good humour and spirits, as well as good stomach, sitting down to dinner with his friends, receives suddenly some very afflicting news. Instantly his appetite is gone, and he cannot swallow a morsel. Let the same thing happen after he has made a hearty, cheerful meal; as suddenly the action of the stomach ceases, the whole power of digestion is cut off totally, as if it were become paralytic, and what he has eaten lies a most oppressive load. Now, what connexion is there between a piece of bad news and a man's stomach, full or empty ? It is, says Cadogan, because the animal spirits, or action of the nerves, whatever be the secret cause of their power, are called off to supply and support the tumultuous agitation of the brain, and the stomach, with all its appendages and secretions, is left powerless and paralytic. In this case, the lungs, which always sympathize with the distresses of the stomach, endeavour to relieve their oppression by a deep sigh.

The principal agent in the process of digestion, is a peculiar fluid, secreted in the stomach, called the gastric juice. The quantity and activity of this singular liquor depend on the contractile power of the digestive organ as a proximate cause ; and on the energy of the whole system, as a remote one. In silent, long continued grief, this fluid is deficient in quantity, and depraved in quality. The chyle is of course vitiated, and the functions of the stomach perverted; its contents become sour, bitter, and rancid. The sufferer pines away for want of a nourishing supply; an universal bad habit of body ensues—a complication of disorders succeeding each other, always from bad to worse; and unless the wretched person can subdue anxiety, he sinks under his misery, and dies, as is said, of a broken heart.

In turning away from this sorrowful picture, I wish you to remember, that it is the stomach which first suffers; and that whatever damps the spirits, injures that organ; and we shall see hereafter, that whatever injures the stomach, depresses the spirits.

Let us now advert to causes more common, and more applicable to the main object of this lecture.

The causes of dyspepsia[†], or bad digestion, the grand inlet of all chronic disorders, arrange themselves under two heads. First, those which act upon the whole body, or particular parts of it, but in consequence of which the stomach is chiefly affected. Secondly, those which act directly and immediately upon the stomach itself. To these we may add a third, viz. Causes which act at the same time upon both.

An indolent and sedentary life, we place at the head of causes which act upon the whole body: next to this,

Trouble of mind, of which we have already spoken: and, lastly,

A rakish life.

Need we go far for arguments, to prove that the only rational creature on earth was destined to exercise and improve the faculties of his mind, as well as the powers of

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[*] From δύς, bad or difficult, and πίπτω, to concoct.

his body. The Parent of universal nature has imposed, kindly imposed on his children, the salutary task of moderate labour, as the best means of preserving their health and their innocence. He has in like manner encouraged them to exercise the towering faculties of their minds, by the contemplation of his works ; and has given them a thirst after useful science, stimulating them to amend their natural condition. He has accordingly decreed, that the prudent exercise of the corporeal and mental powers should strengthen each other. To live a life of indolence, is to sin against one of the first laws of our Creator ; accordingly, we find that the offender is punished with loss of health and spirits.

The time allotted to a lecture is not sufficient to go into a description of the subtle operations of the body. We may remark, generally, that our best health, strength, and spirits, depend on the good and natural state of the minutest and almost imperceptible vessels and nerves of the body. The little diminutive pipes and tubes, the extended continuations of larger vessels, must be kept free and open. 'I consider the body (says Addison) as a system of tubes and glands, or a bundle of pipes and strainers, fitted to one another after so wonderful a manner, as to make a proper engine for the soul to work with*.' The strength of the heart and arteries alone, in a sedentary life, is by no means sufficient to keep up and perpetuate the requisite motion of the fluids through these capillary vessels ; but it requires the assistance and joint force of all the muscles of the body, to propel and accelerate the circulation of the whole mass of blood, in order to keep these minute tubes pervious and clear.

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* Spectator, No. CXV.

That sprightly vigour and alacrity of health, says Cadogan, which we feel and enjoy in an active course of life, that zest in appetite, and refreshment after eating, which sated luxury seeks in vain from art, is owing wholly to new blood, made every day from fresh food, prepared and distributed by the joint action of all parts of the body. No man, says he, can have these delightful sensations, who lives two days with the same blood. To introduce new juices, the old must be thrown off, or there will be no room, there will be too great a plethora or fulness. In a state of indolence or inactivity, the old humours pass off so slowly, the insensible perspiration is so inconsiderable, that there is no void to be filled; consequently, by degrees, the appetite, or desire of supply must daily diminish, and at last be totally lost. To this doctrine, morbid indolence will reply, that this plethoric, or crowded state of the system, with all the disagreeable feelings consequent thereon, may be removed by evacuating medicines. There is no reasoning with those who had rather take a purge, than a walk; or an emetic, than a ride.

Some of you injure your health by too close application to study. Sedentary thoughtfulness will wear out the body, and generate diseases that shorten life. A dyspeptic stomach, emaciated body, and irritable feelings, compose the heavy tax, which men of fine intellects and deep study pay for their eminence. But there is a sort of lazy literature, a kind of suspended animation, which engenders many chronic diseases that embitter and shorten life. This torpid state, in which mind and body are equally stagnant, occassions tasteless meals, perpetual langour, and causeless anxiety. Here the body is not worn, but rusts out. In this state, wine, ardent spirits, and tobacco, are eagerly coveted.

Let us next consider impressions made directly and immediately on the stomach*.

To remove the sinking and dismal langour and dejection, brought on by offending against the first principles of our nature, men turn for a momentary relief to

INTEMPERANCE:

Which is commonly an application of stimulating and narcotic things to the stomach. But who shall define Temperance? a word like liberty, different in signification in different countries. Before you can adjust the criterion of temperance, you should visit some of the colleges on the continent of Europe, where a piece of bread, an egg, or an onion, with a draught of milk and water, is thought a tolerable meal. There is, however, an absolute, determined temperance, measured by every man's unprovoked appetite and consumption; a mean at which virtue takes her stand.

If a man go on daily taking more than he needs or can get rid of, he feels oppressed, his appetite fails, and his spirits sink. Then he has recourse to rich, stimulating food;

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* Opportunities of looking into the stomach of a living subject are very rare indeed. I remember but two instances on the records of medicine.

One was a woman who was in the general hospital at Vienna, in 1798. She had her stomach perforated by a wound which could not be closed up. Through this wound her food might be seen. When any indigestible food created uneasiness, as sour crout, she took the oppressive food out with her fingers, and washed out her stomach with water, and this always relieved her, and revived her appetite. Milk was observed to curdle instantly, except when she had carefully rinced out her stomach. In this case, says Dr. Helme, the coagulation did not take place till after some time, for want, he supposes, of gastric liquor. The coagulation could be expedited by irritating the inner surface of the stomach with the finger.—Asses milk was longer in coagulating than cows milk. The last coagulated in a few moments. Eggs and cheese were quickly digested, but not so soon as flesh meat. Vegetables in general were longer undergoing this process; of these potatoes and carrots passed of soonest.

and though he washes down each mouthful with a glass of wine, he can relish nothing. Thus distressed he applies to the doctor, to give him an appetite! who, after evacuating him upwards and downwards, gives him aromatic bitters, infused in wine or brandy; elixir of vitriol* ; bark, oil of wormwood, steel, columbo; soap, aloes, and rhubarb; quassia, and lime-water. Some of these, by giving contractility to the imbecile organ, afford a short respite to his sufferings. They may moreover effect a transient, but fallacious relief by forcing the concocting powers to squeeze their crude, austere contents into the blood; until at length oppressed Nature resents the injury, in the form of gout, palsy, or apoplexy. A skillful, honest physician will say in such cases,—Your cure can only be found in exercise. A ride, with the cheerful scenery of a new and beautiful country, will give you health, vigour, and vivacity, sound sleep, and a keen appetite. But no drugs can act upon your blood and juices like the joint force of all the muscles of your body acting and re-acting, as in a regular course of moderate exercise; nor can any of our draughts and potions oxygenate your pulmonic blood, like the inspiration of the salutiferous air of the mountains.

"The first physicians by debauch were made;
Excess began, and sloth sustains the trade.
By chace onr long-liv'd fathers earn'd their food;
Toil strung their nerves, and purify'd their blood.
But we, their sons, a pamper'd race of men,
Are dwindled down to three-score years and ten.
Better to hunt in fields for health unbought,
Than fee the doctor for a nauseous draught.
The wise for cure on exercise depend:
God never made his work for man to mend."

DRYDEN.

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* Elixir of vitriol, if long continued, has a pernicious effect on the stomach.

We have said, that the causes producing chronic diseases, arranged themselves under two general heads :—those which act on the whole body, and which affect the stomach in a secondary way ; and those which act directly on the stomach, and affect the whole body through the medium of that organ ; that to these we might add causes, acting upon the whole body and upon the stomach at the same time ; such, for example, as

A rakish life. A rakish life is too well known, to need a description. It is often a halo of misery, surrounding the brightest genius ! To point out its ill effects, would be an insult to your understandings. I might as well labour to convince you of the blessings of health, or the advantages of industry. I pass the subject over in silence, only remarking, in the words of Martial—

> "*Balnea, Vina, Venus, consumunt corpora nostra.*"

Instances of young gentlemen sinking deep into the scandalous habit of drinking ardent spirits, are very rare indeed ; yet it would not be difficult to prove, that there is, and has been for several years, six times as much ardent spirit expended annually here, as in the days of your grandfathers. Unruly wine and ardent spirits have supplanted sober beer. Is it not the case, that some use them of that strength, and in that quantity, which is not consistent with the regular functions of the brain* ? Many,

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* *Of ardent spirits, and wine.*

The art of procuring ardent spirits by distillation, was a discovery of the Arabian chemists. They first obtained it from rice, whence it took its name arrac. At present, it is generally procured by the distillation of fermented liquors. In France, it is drawn from wines. In England, and in Germany, from malt liquors : and in this country, and the West India Islands, from sugar, and from molasses. This ardent spirit, from whatever subject it is obtained, is found, if freed from its phlegm and gross oil, to be essentially warmed by the generosity of youth, may think is consonant with prudence, to drink so as to produce that exhilaration of spirits, which takes place just on this side intoxication; but I hesitate not to pronounce, that the repetition

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the same. By repeated distillations, this spirit is purified, when it obtains the arabic name of alcohol.

Wine is the fermented juice of the grape, and contains three different matters: First, a portion of must, or unassimilated matter: Second, a portion of proper wine, in which, by means of fermentation, a quantity of alcohol is produced: Third, a portion of vinegar, produced by too active or too long protracted fermentation. In new wine, the must will be most abundant; as fermentation advances, the portion of genuine wine will be more considerable; if fermentation has all along been properly managed, vinegar will not appear in any considerable quantity. From the proportion of these several matters, depending on the period and state of the fermention, the qualities of wine may be ascertained. See Neumann's Chemistry, Lewis's Materia Medica, and Motherby's Dictionary.

The Oenus, or wine of the antients, that which Paul recommended, as good for the stomach, was a very different liquor from the wine drank by the English, Irish, and Americans. The wine of the ancients was the pure juice of the grape, rendered active by fermentation; for they were totally ignorant of ardent spirits; whereas our strongest wines contain a fourth part of this fiery spirit, while many of the cheap ones are a vile mixture of deleterious articles, justly ranked among the remote causes of our nervous disorders, palsies, and apoplexies. If one gallon of our strongest bodied wines be submitted to distillation, it yields one quart of spirit, that will burn when thrown on the fire. The quantity of sharp vinegar contained in the same portion of wine, is not so easily ascertained.

We will now present you with a few experiments, demonstrating the pernicious effects of spirituous and vinous liquors, first on the stomach of brutes, and next on the human.

In Bavaria, during the years 1797, 1798, and 1799, the scarcity of fodder compelled them to destroy a great number of horses, employed both for the purposes of war and of agriculture. Dr. Pilger availed himself of this opportunity, and made a number of cruel experiments on nearly two hundred horses, with arsenic, corrosive sublimate, barytes, opium, belladonna, hemlock, laurel water, distilled spirits, wine, and vinegar. After giving horses brandy, so as not only to exhilirate them, but to make them stagger, and even to drop down, he found on opening them, that it shrivelled and of such practices is pernicious to health, and dangerous to morals. Cannot wisdom devise a plan of social intercourse, independent of the stimulus of the bottle? It is said, such plans existed in the city of Geneva, before the French

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contracted the stomach, gave a bloodshot appearance to the intestines, and produced congestions in the brain. But the effect of vinegar was the most remarkable. Concentrated vinegar excited the most dreadful spasms, and produced fatal symptoms. They became extremely weak before death; and in those which were killed in this extreme weakness, the alimentary canal exhibited very little or no irritability on pricking its fibres.

That vinegar is destructive to the human stomach, is known by its effects on plump, healthy females, who, from a silly desire of looking delicate, that is, sickly, swallow daily large draughts of vinegar. This *innocent* practice *only* ruins the digestive faculty, and thereby deprives the system of its requisite nourishment! The only standard of beauty is high health. Dr. Beddoes tells us, that in some of the boarding-schools in England, a keen appetite, and its consequence, *embonpoint*, is held up by the mistress as a dreadful evil; and that starvation and vinegar are encouraged, instead of being severely denounced. Emaciation, thus induced, leads to consumption.

From what has been said, it appears, that some wine makes a twofold attack on our health and happiness. It attacks the stomach as wine, and returns to the charge in the form of vinegar. Hence, in weakly stomachs, when the *ingesta* are composed chiefly of vegetables, and nearly on the point of acidity, a single glass of wine, nay, half a glass, will turn the whole mass into so much thick vinegar. Then come magnesia and lime-water to neutralize the vinegar bottle! Who then but must see the absurdity of throwing a glass of wine into a dyspeptic stomach, directly after a dinner composed chiefly of vegetables? Yet it is constantly done, to the unspeakable distress of the sufferer, agonizing with wind and acid. Physicians should endeavour to convince such patients, that wind and acid are not the causes, but the consequences of a torpid, imbecile stomach. They should be told, that when a healthy stomach is moderately filled with vegetables, and well roasted, or well boiled meat, neither air, nor acid is to be found in the whole alimentary canal.

Of the pernicious effects of wine on children.

The best informed European physicians condemn the practice of giving wine daily to children. It has become a prevalent custom of late in Ameinflicted the benefits of *their* liberty on that philosophic people.

Among the causes which act directly and immediately on the stomach, we mentioned, besides ardent and vinous spirits, certain narcotic substances.

rica, to give a glass of wine to such children as are old enough to sit at table with their parents. If the opinion of experienced physicians have no weight with parents, the following well-conceived experiment, being proof positive of the pernicious effects of wine, may possibly induce some to reflect a little on the subject.

A physician of great eminence in London, gave to one of his children a full glass of sherry every day after dinner, for a week. The child was about five years old, and had never been accustomed to wine. To another child, nearly of the same age, and under similar circumstances, he gave a large China orange, for the same space of time. At the end of a week, he found a very material difference in the pulse, the heat of the body, the urine, and the stools of the two children. In the first, the pulse was quickened, the heat increased, the urine high-coloured, and the stools destitute of their usual quantity of bile; while the second had every appearance that indicated high health. He then reversed the experiment; to the first mentioned child he gave the orange, and to the other the wine. The effects followed as before:—A striking and demonstrative proof of the pernicious effects of wine on the constitution of children in full health.

This accurately executed experiment is related by Mr. Sandford, surgeon at Worcester in England, and quoted by Dr. Beddoes in his *Hygëia;* who thus remarks on it, " that the deficiency of bile is full evidence of the injurious effects of wine upon the digestive organs in this double experiment." Yet we find that some physicians have learned their patients to attribute these very complaints to a redundancy of bile! and therefore prescribe salt of wormwood and rhubarb, or soap, rhubarb, and aloes; inducing thereby a farther weakness of the digestive organs, the proximate cause of the disorder. My venerable preceptor, Dr. Fothergill, cured such complaints with fresh made porter. By the time London porter arrives in America, it contains too much vinegar to be serviceable in these cases.

Mahomet, with a view to temperance, forbad his followers to drink wine; and in order to correct their savage custom of eating raw flesh, as do the Abyssinians to this day, he allowed them to eat any thing that had passed through fire; meaning, whatever had undergone the process of

Narcotics are soporiferous drugs, which induce stupefaction. It is the property of narcotics, to exhilarate first, and then to relax and stupify. They invariably debilitate the organs to which they are immediately applied; at length, they have a similar effect on the whole system. At the head of this class of drugs we place *opium**, which is the milky juice that exudes from the heads of poppies, when incisions are made in them, and then gradually dried in the sun. To this class belong also, *cicuta*, or hemlock; *belladonna*, or deadly nightshade; *stramonium*, or apple of Peru; and *nicotiana*, or tobacco.

The Turks, who were forbidden by Mahomet to drink wine, intoxicate themselves with opium. It is said, that some will eat more than an ounce in a day. We have seen, that nothing so effectually preserves health, and prevents disease, as maintaining the tone and regular motions of the digestive organs; and there is no drug in common use which renders them so torpid, and which so effectually stagnates their functions, as opium. After destroying the energy of the stomach, it undermines the powers of all the other organs in succession, even to the organ of *thought*. Travellers inform us, that the visage and general appearance of the opium-eaters in Turkey, are the most disgusting imaginable, even worse than our most abandoned rum-drinkers. Some of these miserable Turks have, however,

cookery. A century or two after his death, the chemists of his country discovered the art of drawing ardent spirits from rice, by distillation. When these Mahometans were reproached for intoxicating themselves with this spirit, which they called arrac, they replied, that it had passed through the fire, and was therefore agreeable to the laws of Mahomet, as expressed in the Koran.

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* Galen was the first of the Greek writers who mentions opium. It was but little used among the ancients. Paracelsus and Silvius de la Bois brought it into vogue in Europe. Sydenham used it first in small-pox.

mind enough left to destroy themselves by the dagger, to prevent living, or rather *breathing* a few years longer, in a state of confirmed idiotism, which is the fate of most of them during the latter years of their existence. Thus much for opium :—but what shall we say of *Nicotiana**, our beloved Tobacco?

With what caution should a man proceed, in attacking a favourite of the people? A prudent man, one who wishes to sail quietly down the popular stream, would be disposed rather to flatter and applaud the object of their affections. But an honest man, who differs a little from him, commonly designated as a prudent one, can never flatter where he feels a friendship. He will give the true character of a dangerous inmate, and warn his friends of the consequences of cherishing a viper in his bosom. You already perceive, that although we would give "fair play" even to a treacherous enemy, yet tobacco has done, and is secretly doing too much mischief, to expect any more from us, than a severe trial, and rigorous justice.

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* *Nicotiana*, so called from Jacobus Nicotius, ambassador to the court of Portugal from Francis II, king of France. Nicotius bought some seeds of this plant from a Dutchman, in 1560, who had just brought them from America. From this seed the plant was produced in France. Sir Francis Drake carried it into England; and Sir Walter Raleigh first brought it into Fashion. The dried plant was afterwards imported in great plenty from Tobago, and hence it obtained the name of Tobacco.

Linnæus places this genus of vegetables in the first section of his fifth class, which contains those plants whose flowers have five stamina and one style, which, expressed in botanical language, is *Pentandria Monogynia*. This genus has eleven species, one of which is called *Hyoscyamus*, from its agreeing in several of its characters with the deleterious henbane.

Nicholas Monardus, a German, has written a folio on the virtues of tobacco. It is, doubtless, a valuable medicine, especially in cases where the *Digitalis* has been used without success. An English physician, Dr. Fowler, used a tincture of tobacco in fifty-two cases of dropsy, and found it efficacious in forty-nine of them. The same physician found it very beneficial in dysuries from gravel. I have used it in such cases with satisfaction.

The great Linnæus has, beside his celebrated *artificial* classification, given us a *natural* one. In his natural arrangement, he has placed tobacco in the class *Luridæ*; which signifies pale, gastly, livid, dismal, and fatal. To the same ominous class belong, foxglove, henbane, deadly nightshade, and another poisonous plant, bearing the tremendous name of *Atropa,* one of the furies. Let us examine one of them, viz. Tobacco, its qualities, and its effects on the human constitution.

When tobacco is for the first time taken into the mouth, it creates nausea and extreme disgust. If swallowed, it excites violent convulsions of the stomach and of the bowels, to eject the poison either upward or downward. If it be not very speedily and entirely ejected, it produces great anxiety, vertigo, faintness, and prostration of all the senses, and in many instances death has followed. The oil of this plant is one of the strongest of vegetable poisons, insomuch, that we know of no animal that can resist its mortal effects. These are, without exaggeration, some of the lurid qualities of our beloved tobacco. Let us now see if it can be agreeable to the laws of the animal economy, or consonant to common sense, that a plant with such qualities, can act otherwise than detrimental to the tender constitutions of young persons.

The human organs are endowed with a faculty of selecting certain wholesome articles; and our digestive apparatus, of assimulating and changing them into our own nature and substance. Beside this nutritive faculty, our organs are endowed with a repulsive one,—with certain instincts, or perceptions, by which they reject whatever is unwholesome or pernicious to our well being. These powers and faculties, purely instinctive, are more or less possessed by every healthy animal. Man, endued with reason, has these instincts in less perfection than the brutes.

The organs of the senses are so many guards, or centinels, placed at those avenues where death is most likely to enter. For illustration, let us suppose a man cast ashore on some uninhabited island, and roaming among unknown fruits and herbs, with a desire to satisfy his hunger; he knows not whether what he finds be wholesome or poisonous. What naturally follows? The first examination which the vegetable undergoes, is that of the eye; if it incurs its displeasure, by looking disagreeable and forbidding, even this may induce him to throw it away; but if it be agreeable to the sense of seeing, it is next submitted to the examination of the smell, which not unfrequently discovers latent mischief, concealed from the sight; if not displeasing to the sight, nor disagreeable to the smell, he readily submits it to the scrutiny of the next guard, the tongue; and if the taste too approve of the choice, he no longer hesitates, but, eating it, conveys it into his stomach and intestines; both of which, like faithful body-guards, are endowed with a nice perception and prompt action, by which, if what was eaten as wholesome food should, notwithstanding all the former examinations, still possess a latent quality injurious to life, the stomach is stimulated to reject it upward, or the intestines to expel it downwards. These internal perceptions, and consequent exertions, are the first and most simple acts of Nature, being purely instinctive, constituting what physicians call the "*Vis medicatrix naturæ*," or re-action of the system*.

Let us suppose, that our hungry adventurer had fallen on the tobacco-plant; he would find nothing forbidden in its appearance; to his smell it would be rather ungrateful;

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* See Mr. Mudge's Essay on the *Vis Vitæ*.

to his taste so nauseating, that it is surprising how the same man ever ventured to taste green tobacco twice; but if taken into his stomach, convulsions, fainting, and a temporary loss of his senses, follow; accompanied with violent and nasty operations. If that which is wholesome affect the senses of animals with pleasure, and invite them to convert it into their own juices; and if that which is unwholesome excite disgust in smell, taste, and appetite, then would our adventurer rank this herb among poisons, and note it as one of those which Nature forbade him to use. Yet man, by perverting his nature, has learnt to love it! and when perverted nature excites a desire, that appetite or desire is inordinate and ungovernable: for the re-action, or physical resistance, will, like that of the moral, lessen in proportion to the repetition of the attacks; and then those guards of health, already mentioned, desert Nature, and go over to the side of her enemy; and thus we see how intemperate drinking, and immoderate smoking, began their destructive career.

The first effect of tobacco on those who have surmounted the natural abhorrence of it, and who have not only learnt to endure it, but even to love it, and who have already commenced the nasty custom of chewing or smoking, is, either a waste or vitiation of the saliva.

The saliva, or spittle, is secreted, by a complex glandular apparatus, from the most refined arterial blood, and constantly distils into the mouth in health, and from the mouth into the stomach, at the rate of twelve ounces a day [*]. It very much resembles the gastric juice in the stomach; and its importance in digestion may be imagined, after listening to the words of the great Boerhaave. 'Whenever the saliva is lavishly spit away, we remove one of the strongest causes of hunger and digestion. The chyle, prepared without this fluid, is depraved, and the blood is vitiated for want of it. I once tried,' says this great philosopher and consummate physician, 'an experiment on myself, by spitting out all my saliva; the consequence was, that I lost my appetite [*].' Hence we see the pernicious effects of chewing and smoking tobacco. I am of opinion, that smoking tobacco is very pernicious to lean and hypochondriacal persons, by destroying their appetite, and weakening digestion. When this celebrated plant was first brought into use in Europe, it was cried up for a certain antidote to hunger; but it was soon observed, that the number of hypochondriacal and consumptive people were greatly increased by its use [†]. The celebrated Cullen says, 'a constant chewing of tobacco destroys the appetite, by depriving the constitution of too much saliva [‡].'

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[*] Boerhaave's Academical Lectures.

One of the kings of Spain was afflicted with a very offensive breath; to remedy which the physicians advised his majesty to chew a composition of gum arabic, ambergris, and other perfumes, the use of which occasioned a great expenditure of saliva. The courtiers, either out of compliment to their sovereign, or, what is more probable, from the vanity of imitating their superiors, went very generally into the same custom. The consequence was, that they who followed the fashion with most ardour, lost their appetites, and became emaciated; and consumptions increased so fast among them, that the practice was forbidden by royal edict.

Some do not eject the saliva, but prefer swallowing the nasty mixture, which seldom fails to induce faintness, palpitations of the heart, trembling of the limbs, and, sooner or later, some serious chronical inconvenience.

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[*] Females who spin flax, and the manufacturers of straw bonnets, suffer from the same cause.

[†] Boerhaave's Academical Lectures.

[‡] Cullen's *Materia Medica*.

After what has been said, who can doubt of the bad effects of constant application of powdered tobacco to the delicate membrane of the nose; especially if they know what a thin partition divides the olfactory cavity from the brain ‡?

I have been a Professor in this University twenty-three years, and can say, as a physician, that I never saw so many pallid faces, and so many marks of declining health; nor ever knew so many hectical habits and consumptive affections, as of late years; and I trace this alarming inroad on your young constitutions, principally to the pernicious custom of smoking *cigarrs* *.

It is allowed by all, that since the foundation of this College, the custom of smoking never was so general; it is conceded by all, that individuals never pushed the fashion to such extent; and it is confessed by all, that the inhabitants of this place never appeared so pallid, languid, and unhealthy. I will not say, with some, that symptoms of languor have been discernible in your public performances; nor am I disposed to attribute it wholly to the causes mentioned in this lecture. I believe some of you study more than is consistent with health, and exercise less than is necessary for persons of your age. I feel a particular solicitude for such worthy characters as become sickly by indiscreet diligence; and I entreat them to consider, that the habit of smoking increases muscular indolence. Nor is this all—smoking creates an unnatural thirst, and leads to the use of spirituous liquors. I will not vouch for the truth of the common observation, that great smokers are generally tipplers. They appear to be, however, different strands of the same rope.

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‡ Too constant use of strong snuff brought on a disorder of the head, which was thought to have shortened the life of a celebrated divine and accomplished gentleman:—" *cujus etiam a lingua melle dulcior fluebat oratio*."

* Cigarr, from the Spanish *Cigarro*, a little roll or tube of tobacco: *Tabaci folia in tubulum convoluta.* A cigarr is a leaf of tobacco formed into a small twisted roll, somewhat larger than a pipe stem, of about six inches long. The smoke is conveyed through the winding folds, which prevent it from expanding; there is, however, a small aperture made through the middle by a wire. The cigarr preceded the invention of the pipe. The best come from the Havanna: those most esteemed are made in the convents.

Do you not, Gentlemen, see clearly, that this nasty, idle custom includes the insidious effects of indolence; the deleterious effects of a powerful narcotic fumigation; and the pernicious effects consequent to the use of ardent and vinous spirits,—destructive agents to men, but which act with redoubled force on the more susceptible frames of youth? I appeal to experience. I ask, whether he who indulges himself in this way, does not awake in the morning, hot, restless, and dissatisfied with himself? The sound of the bell grates his nerves. Even the

"Prime cheerer, light,
"Of all material beings first and best †,"

is an unwelcome intruder. He dresses with languor and fretfulness; his mouth is clammy and bitter; his head aches, and his stomach is uneasy, till composed a little by some warm tea or coffee. After stretching and yawning, he tries to numb his irksome feelings by a cigarr and a glass of wine, or a little diluted brandy. These disagreeable sensations will, however, come and go, through the course of the day, in spite of all his soporifics. By evening, a handful of cigarrs, a few glasses of wine, &c. re-

† Thomson.

move, by their stronger stimulus, these troublesome sensations; when he tumbles into bed, and rises next morning with similar feelings, and pursues the same course to get rid of them. Does not this look like a faithful extract from the diary of "a Blood?"

I am entirely convinced, that smoking and chewing injure ultimately the hearing, smell, taste, and teeth. "Good teeth," says Hippocrates, "conduce to long life;" because he who does not masticate his food properly, and mix it thoroughly with a due portion of saliva, will find his digestion fail; and this failure will gradually open the avenues to death.

The practice of smoking is productive of indolence, and tends to confirm the lazy in their laziness. Instead of exercising in the open air, as formerly, you sit down before large fires, and smoke tobacco. This hot fumigation opens the pores of the head, throat, neck, and chest; and you pass out, in a reeking sweat, into a damp, cold atmosphere; the patulent pores are suddenly closed; hence arise disorders of the head, throat, and lungs. These causes, co-operating with those already mentioned, produce those hectical symptoms and consumptive complaints, that have been multiplying among you to an alarming degree; for this nasty custom includes the destructive effects of indolence, and the pernicious effects of the too frequent use of vinous and ardent spirits; agents destructive to full grown men; but which act with redoubled force on the more susceptible frames of young gentlemen in the spring of life.

Some have said, and the observation carries with it a handsome compliment, "that smoking cannot be an evil custom, seeing most of the clergy follow it." I am mortified that such authority can be adduced to oppose our advice. I will nevertheless, venture to warn you, who expect to be cloathed with the sacred function, against this inconvenient practice, until you are at least fifty years of age. As a sedentary man advances in life, he perspires less, while his lungs labour more. There is an accumulation of viscid phlegm among the inert and almost insensible solids of the lungs in elderly people, which, in our cold months, especially in February and March, produces a kind of chronic catarrh, or humoral asthma; for which smoking is beneficial. Here tobacco is a safe and efficacious pectoral*. There is, however, a doleful difference between the case of a man of sixty-five taking three or four pipes of tobacco in twenty-four hours, and a boy of seventeen, who uses ten or a dozen cigarrs in that time. In one, the cold and inert fibre is warmed, and animated to throw off an offensive load; in the other, it is adding fuel to fire, and irritating glands already sufficiently stimulated by his youthful nature.

The gentlemen of the clergy drink sparingly, even of wine; but many, who indulge in smoking, drink enormous quantities of hot tea †, which Boerhaave observes to be one of the pernicious consequences of smoking tobacco: as it assists to bring on hypochondriac and other dismal disorders. By forbearing to do what may innocently be done, we may add hourly new vigour to resolution. I can hardly believe there ever was a rigidly virtuous man, who became a slave to tobacco. To set the mind above the appetite, says the British moralist †, is the end of abstinence; and abstinence is the ground-work of virtue. For want of denying early and inflexibly, we may be inticed into the recesses of indulgence, and sloth and despondency may close the passage to our return.

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* We allow tobacco as a remedy, not as an amusement.

† Coffee and tea are articles friendly to morals, seeing they frequently exclude the use of spirituous liquors. The French and Spaniards take coffee directly after dinner, instead of wine: a custom worthy of imitation. A physician is often asked, which is most wholesome, tea, or coffee? Either of them, made very strong, must be injurious; both certainly suspend the inclination to sleep, and impede digestion. Tea or coffee, of moderate strength, and drank with discretion, is found by experience friendly to the human constitution. Old smokers will sometime drink a dozen dishes of tea, and destroy thereby the tone of their stomachs. Young smokers also suffer from the same cause. One of the most speedy methods of weakening the stomach is, to smoke cigarrs, and at the same time swill tea or coffee, and eat an enormous pile of toast, swimming in butter. We have said already, that the use of the saliva was, to assist, with the bile,

I hope that those of the clergy who follow remarkably this custom, will receive kindly what I utter seriously, respectfully, and affectionately. Strengthen, I beseech you, the minds of these youth, to relinquish a habit, which, you know, requires some exertion. If you want an excitement, look at that consumptive young man, whose emaciated figure strikes you with horror; see his forehead covered with drops of sweat; his cheeks painted with a livid crimson; and his eyes sunk; his pulse quick and tremulous; his nails bending over the ends of his fingers; and the palms of his hands dry, and hot to the touch. His breath offensive, quick, and laborious; his cough incessant, scarcely allowing him time to tell you, that he smoked cigarrs without number; drank brandy and water, and wine; played daily on the flute ‡; and coming home one night from a crowded musical meeting, caught cold;

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to mix butter and fat with the watery part of our food; but, in such a meal, the saliva is either spit out, or vitiated; and the incongruous mass is left to sour, because the principal mean of assimilation is withdrawn.

† Johnson.

‡ Playing on wind instruments, as well as singing, are pernicious to persons predisposed to consumption.

which, being neglected, brought on a cough, short breath, expectoration of purulent matter, and night sweats; which soon hurried him on to what you see.

Of the seemliness or decency of the practice of smoking and chewing tobacco, more may be said, than you will have patience to hear. Boerhaave observes, that " it is allowed by the universal consent of the more civilized nations, that spitting in company is both unmannerly and nasty; insomuch, that among the inhabitants of the East, it was held in the highest detestation and abhorrence!" A physician should never use tobacco in any form, as some weak patients will faint at the smell †.

The fashion of smoking tobacco was introduced into England, by Sir Walter Raleigh, in the reign of James I. The custom was followed by almost all the nobility and high officers of the realm, to the great dissatisfaction of the fastidious monarch. So universally prevalent was this fashion, that his majesty could not readily find any one to write or preach against it. He therefore wrote a tract himself, which he entitled, " A counter Blast to Tobacco," a copy of which may be seen in the library of this University. After exposing in strong language the unhealthiness and offensiveness of this practice, he closes with this royal counter blast:—" It is a custom loathsome to the eye, hateful to the nose, harmful to the brain, dangerous to the lungs; and, in the black, stinking fume thereof, nearest resembling the horrible Stygian smoke of the pit that is bottomless!"

To conclude.——The moral, to be deduced from our whole Lecture, is, the necessity of avoiding all predisposing

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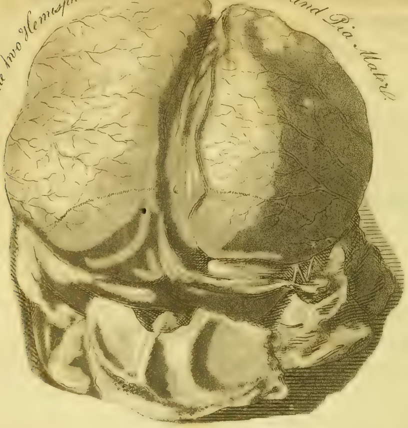
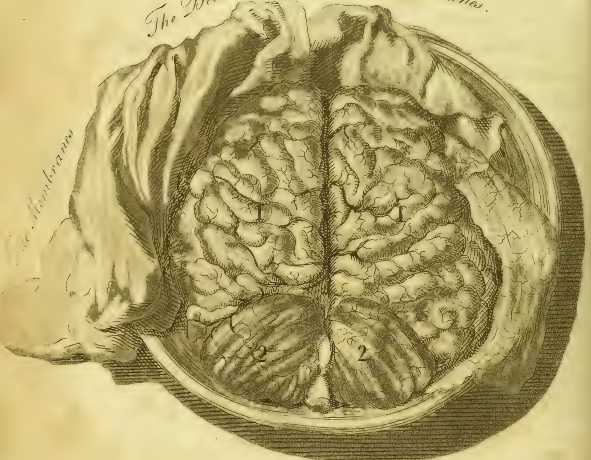
† The custom of smoking has for a considerable time past been totally banished from all polite companies in England. It is there confined to taverns and alehouses.

The Brain.

The two Hemispheres covered with the Dura and Pia Mater.



The Brain devested of its Membranes.



11. The Cerebrum
22. The Cerebellum.

causes to nervous disorders, and obviating the remote causes of consumption. Quit, then, this pernicious habit, I entreat you.—Take all your cigarrs and tobacco, and in some calm evening carry them on to the common, and there sacrifice them to health, cleanliness, and decorum.

SECTION XXXIII.

OF THE BRAIN AND NERVOUS SYSTEM.

> May not animals have a power of extracting from the blood the *electrical fluid?* The BRAIN then would be the great laboratory for this purpose.——PRIESTLEY.

It would be foreign to this publication to enter here into a minute description of the BRAIN, the MEDULLA SPINALIS, and the NERVES which proceed from thence, affording *sensation* and *motion* to the different parts of the animal frame. Suffice it then to say, that these are composed of two distinct parts; the MEDULLARY, OF FIBROUS; and the CORTICAL PART, OF VASCULAR; which parts are invested by their proper membranes, called the PIA, and DURA MATER. also the Tunica Arachnoides

The *outer* or *cortical part* of the brain, spinal marrow, and nerves, are exceedingly *vascular*. Rhuysch has made this very evident by his preparations. After a successful injection of his ceraceous matter into the carotid arteries, he found the cortical part of the brain became red; then separating a red portion of it from the rest, but cohering with the branch of an artery, and macerating it in water, till the membranes putrified and dissolved off, he put what remained in spirits of wine, and found it to be red, very tender, flocculent, a fleecy, coherent substance, filled and tinged red, as far as the injection had reached; the oily nature of which had hindered it from being dissolved in water, as the membranes, and other parts that were not filled, had been. Such preparations Rhuysch often made, and found the experiment succeed in like manner with the CEREBELLUM, SPINAL MARROW, and NERVES.

Now we have before shewn, that in every contraction of the heart, a very large quantity of blood was sent almost in a straight line from the heart, and therefore the blood, from its proximity to the brain, must move with a proportionate velocity. Haller computes that the heart sends to the brain one-sixth of the whole mass of blood, Monro at less. Let us therefore suppose, that the quantity thrown out by the left ventricle, at every pulse, is only one ounce and a half, which is a very low value, as the exactest and latest measures of the capacity of the ventricle run from one to three ounces. A sixth part of this is a quarter of an ounce. Let us take the number of pulses to be 60 in a minute, or 3600 in an hour, which is a very slow pulse. By this estimate, 900 ounces, or fifty-six pounds and four ounces, of *oxygenated* or arterial blood must arrive at the cortical part of the brain in an hour, which amounts to 1349 pounds in the natural day to be returned to the four jugulars back again to the heart *unoxygenated.*

As so great a quantity of blood arrives at the brain in so short a space of time *oxygenated* (and though it were taken double, there would be no exaggeration of the matter), and passes thence *unoxygenated*, is it not reasonable to suppose, that in the subtle vascular texture of the *cortical substance* there is strained off, or secreted from the *arterial blood*, a fluid, the finest, most attenuated, and most moveable in all the animal body, a fluid analogous to the matter of fire, or the *electric fluid?* and since the *medullary* *substance* of the brain is of a *fibrous composition*, the threads of which are disposed in a parallel direction (as is particularly obvious, even to the naked eye, in the corpora striata, the thalami of the optic nerves, especially of fishes, in the fornix and other parts of the brain when immersed in the nitrous acid), does not this subtle and penetrating fluid therefore cling to the MEDULLA, and pass along the NERVES at the command of the will, which are evidently of the same texture as the *brain*, just as the *electric fluid* is retained by the *main conductor*, and passes along a *wire* connected to it? If so, we have answered the question proposed by Sir Isaac Newton, " Is not *Vision* produced " by an *ethereal fluid*, or something analogous to this me- " dium, excited in the bottom of the eye by the impulse " of light, and propagated along the solid, pellucid, and " uniform fibrillæ of the optic nerves to the place of sen- " sation?"——" And is not *Hearing* performed by the " movement of this, or some other analogous fluid, excited " in the auditory nerves by the percussion of the air along " the solid, pellucid, and uniform fibrillæ of those nerves " into the place of sensation, and so of the *other senses?*" —If so, these threads or fibres, called NERVES, are so many *electric conductors*. The *electricity* of each fibril is excited apart, and each part impresses a stroke upon the brain, which is proportioned to the impulsion they receive, and to the excitement of the *electric matter*. In this case, every nerve excites distinct impressions. Not only several impressions are made at the same time, but they are affected with a rapidity that refutes the idea of sluggish matter, and which belongs uniquely to the *electrical fluid*. One may hear three or four sounds in succession, very distinctly, in the space of a quarter of a second. Between the time of touching a body, and the consciousness of it taking place, there is scarce any intermediate space which can be calculated by the known measures of time. However the sensation *remains* for a short time after the object is gone. Thus, to use again the expressions of the immortal Newton, "If a stick burnt at one "end be nimbly moved round in a circle, with gyrations "continually repeated, the whole circle will appear like "fire; the reason of which is, that the sensation of the "burning body, in the several places of that circle *remains* "impressed upon the brain until the burnt end returns "again to the same place. And so in the quick conse"cution of colour, if all the several colours into which "light may be divided by the prism, be painted on a card "in their due proportion, and whirled round any pointed "body, the impression of every colour *remains* on the "sensorium, until a revolution of all the colours be com"pleted, and that first colour return again. The impres"sions therefore of all the successive colours *are at once* "*in the sensorium*, and beget a sensation of *white*."—Thus also common *electricity* has a loitering pace, not easily reconcileable with its common immeasurable velocity.

The causes which excite sensation being without the body; to wit, the objects of the five senses; and external with respect to the medullary part of the brain, is it not reasonable to infer, that sensation is produced by the reflux of the *electric* or *nervous fluid* moving along the nerves towards their origin, occasioned by the impulse of its objects or causes? Or is this fluid expended, and drawn off, and sensation the result of the determination of the *electric*, or nervous fluid, to the part stimulated?

In the exercise of voluntary muscular motion, it is no less natural to conclude, that the *electric fluid* is, by an effort of the mind, operating in a manner instantaneously, sent from its origin in the beginning of the medullary part, along the nerves, which are continued into the mechanism of the muscles.

With respect to the operations of the mind or soul, as *will*, *consciousness*, *memory*, *imagination*, *judgment*, &c. it is reasonable to suppose, that these are attended with respectively different motions of the NERVES, the CORTICAL and MEDULLARY PART of the BRAIN, which is an organ the masterpiece of creative skill. We see this verified every day, when more or less of stimulating food, altering the action of the heart, a few drops of a certain liquor, or some grains of opium, entirely change our manner of seeing things, and consequently of judging of them. Do we but stand for a few seconds on our head, or turn round, and alter in the brain the current of blood, and how is the image of man, erect, and viewing the heavens, reversed! He who could exclaim, "*These are* THY *wondrous works*; *how wondrous then* THYSELF!" If more or less blood, or that not duly supplied with the vital principle in the air, be transmitted to the brain, how would the ideas of this sublime poet, respecting hideousness and holiness, vice and virtue, be confounded! In the delirium of a fever, even in the mind of a Locke, how unproportioned to the reality would be the representation of things!

Moreover, as the faculty of thinking in general ripens and comes to maturity with the body, it is also observed to decay with it; and if, in some cases, the mental faculties continue vigorous in extreme old age, or when the body is enfeebled, it is evidently because, in such particular instances, the brain is not much disturbed by the general cause of bodily weakness. But, on the other hand, if the brain itself be disturbed, as by actual pressure within the skull, by tumours, abscesses, inflammation, and, in a natural way, by sleep, the mental faculties are always proportionably affected.

At Paris there was a man whose head had been broken and trepanned. If the silver plate was removed, and the *cortical part* of the brain pressed, his sight would become dim! and if the pressure was increased, he would exhibit the abolition of sense and motion, or apoplexy, and immediately upon taking away the pressure (which he earnestly begged might be continued but a very short time), all his faculties returned unhurt.

The connexion of *mind* and *matter*, however, must not be *confounded.* The UNDERSTANDING, indeed, is the result of *mechanism.* The brain is an infinite assemblage of minute threads. These acquire force by exertion; thus, in learning to repeat by memory, the *electric* impulse of each word becomes concatenated, so that by reading the same thing over and over again, the whole lesson is acquired; thus the multiplication table is readily got by rote, and, when a boy is asked, how much is 4 times 9? he begins 4 times 4 is 16, and so gets down at last to 4 times 9 is 36.

To evince *the fibrous structure* of the *organs* of *sense*, the *retina* of an ox was suspended in a glass of warm water, and some caustic alkali being added to it, as the adhering mucus was corroded, the *hair-like fibres* remained floating in the vessel.

Hence it seems, that the *organs* of *sense* are composed of *minute fibres*; and it is probable that the *locomotive muscles*, as well as the *vascular ones*, of microscopic animals have much greater *tenuity* than *these fibres* of the *retina.*

Besides the *similar laws*, which will be shewn in this volume to govern alike the actions of *sentient* and *muscular fibres*, there are many *other analogies* which exist between them.

They are both originally excited by *irritations* from without, are *alike* strengthened and fatigued by exertions, are *alike* painful if excited into action when *inflamed*, and are *alike* subject to *spasm*, *paralysis*, and the *torpor* of declining years.

The *retina*, as was before shewn, is an expansion of the optic nerve. Its branches are composed of infinite fibres. A part of these being exercised conveys a distinct idea. If the impulse be strong, the object is clear; if weak, the object is distant, and confused.

It is probable that sight bears no reference to the image of objects; no more than a looking-glass sees, because it reflects the image of different objects: the image on the concavity of the eye is topsy turvy, and double to those who have two eyes; but the idea is the result of *impression* upright and single.

By this organ we can clearly explain our notion of INTELLECT as dependant upon *mechanism*. If the mechanism of the eye be defective, we can acquire no ideas which result from this sense. If the optic nerve be palsied, or, on the contrary, if inflamed, that is, supplied with too much *blood*, or if *jaundiced*, sight is lost or imperfect; or if we make gyrations round one foot with the eyes shut, when we afterwards open them, the image of objects will appear in rotatory motion.

The anatomist, contemplating the *different structures* wherein the *same offices* are designed by an OMNIPOTENT POWER, discovers, " *that in animals the differences in structure affixed to the organs of sensation constitute the main differences in perception*;" for where the sense of smell, &c. as in the dog, is more acute than in us, the figure of that organ is more complex, and disclosing a greater degree of art: and " *that the powers of the nerves depend on the structure of the parts to which they are connected.* Thus the nerve, which goes to the tongue, gives the sensation of taste, and supplies also the muscles moving that organ. The par vagum, which gives sensation to the stomach and lungs, likewise affords the power of motion to the muscles of the throat. And thus the sensation of touch may arise from the same nerves which pervade the muscular fibres.

This doctrine is beautifully displayed by the invaluable museum prepared by that first of anatomists and naturalists, the late John Hunter.

Many parts of the human body being so complex, that their structure could not be understood, nor their uses ascertained, Mr. Hunter was led first to examine similar parts in other animals, in which the structure was more simple, and more within the reach of investigation; this carried him into a wide field, and laid the foundation of his vast collection in comparative anatomy.

The collection of comparative anatomy which Mr. Hunter has left, and which may be considered as the great object of his life, must be allowed to be a proof of talents, assiduity, labour, and original genius. The idea appeared too vast for man. Of him it may with juster propriety be said than of any other man, "Deus creavit, Hunterus disposuit;" whose genius cannot be contemplated without surprise and admiration.

In this collection we find an attempt to expose to view the gradations of nature, from the most simple state in which life is found to exist, up to the most perfect and most complex of the animal creation—man himself.

By the powers of his art, this collector has been enabled so to expose, and preserve in spirits or in a dried state, the different parts of animal bodies intended for similar uses, that the various links of the chain of perfection are readily followed and may be clearly understood.

This collection of anatomical facts is arranged according to the subjects they are intended to illustrate, which are placed in the following order:

First, parts constructed for motion.

Secondly, parts essential to animals respecting their own internal œconomy.

Thirdly, parts superadded to purposes connected with external objects.

Fourthly, parts relative to the propagation of the species and maintenance or support of the young.

The FIRST CLASS exhibits the sap of vegetables and blood of animals, from which fluids all the different parts of the vegetable and animal creation are formed, supported, and increased. These fluids being more and more compounded, as the vegetables and animals become more perfect, are coagulated and form a regular series. The sap of many plants does not coagulate spontaneously, but is made to undergo this change by adding the extract of Gowlard, in this respect differing from water: the sap of such plants is considered as the most simple; in the onion there is a spontaneous coagulation: in insects the blood coagulates, but is without colour: in the amphibia, colour is superadded.

The moving powers of animals, from the simple straight muscle to the most complicated structure of that organ, with the different applications of elastic ligaments, form a *second series.*

The growth of bone, horn, and shell, come *next in order*; and the joints which admit of their moving readily on one another, *finish* this subject.

The SECOND CLASS begins with those animals of the hydatid kind, which receive nourishment, like vegetables, from their external surface, having no mouth.

Then follow those which are simply a bag or stomach, with one opening, as the polypus, having no organs of generation, as every part of the bag is endowed with that power; but in the leech the structure becomes more complex, for although the animal is composed of a bag with only one opening, the organs of generation, brain, and nerves, are superadded, and thence a gradual series is continued to those animals in which the stomach forms only a distinct part of the animal, for the purpose of digestion.

The stomachs themselves are also arranged in the order of their simplicity.

First, the true membranous digesting stomach, then those with the addition of crops, and other bags, to prepare the food for digestion, as in the ruminating tribe, and, lastly, those with gizzards.

Annexed to the stomachs, is a very complete and extensive series of teeth, which are varied according to the kind of food and stomach.

After the stomachs are the different appearances of the intestinal canal, which exhibit almost an infinite variety in the structure of their internal surface from which the aliment is absorbed.

The quantity of surface is increased in some by transverse folds, in some by spiral or longitudinal ones, and in others puts on a loculated appearance, as in the whale.

To these are added the glands, connected with the intestines, as the liver, pancreas, and spleen, which may properly be considered as appendages.

After digestion, follows the system of absorbing vessels, the simplest being the roots of plants, after which are the lymphatic and lacteal vessels of different animals.

These in the human subject and the elephant are small, and in the turtle large and more numerous; but in the spermaceti whale, where they are employed for conveying the spermaceti, of a size infinitely beyond what is met with in any other animal. To these are annexed the thoracic ducts in different animals.

The natural order, in following the course of the aliment from the stomach as a guide, leads from the absorbents to the heart, which in the caterpillar is a simple canal or artery running along the middle of the back of the animal, admitting of undulation of the blood; from this simple structure it becomes, in different animals, by small additions, more and more complex, till it arrives at the degree of perfection which is displayed in the organization of the human heart.

These are followed by the different structures of valves in the arteries and veins, and the coats of these vessels.

Then the lungs are shown in all their gradations from the simple vascular lining of the eggshell, which serves as lungs for the chicken, to those of the more perfect animals.

In one instance, viz. that of the syren, both gills and lungs are seen in the same animal.

The wind pipe and larynx are then shewn, under all their different forms.

The kidnies, which separate the superfluous fluids from the circulation, make the last part of this subject.

The THIRD CLASS takes up the most simple state of the brain, which is in the leech a single nerve with ramifications.

In the snail, the brain forms a circular nerve, through the middle of which passes the œsophagus, from which circle there are branches going to every part of the skin of the animal.

In the insect, the brain has a more compact form, is larger in fish, but still more so in birds, gradually increasing in size as the animal is endowed with a greater degree of sagacity, till at last it becomes the large complex organ found in the elephant and in the human subject.

The coverings of the brain, and the ganglions and peculiarities of the nerves are annexed.

The organs of sense are arranged in the order of their simplicity, beginning with that of touch, which is only a villous vascular surface, the villi very short where the impression is to be made through a thin cuticle, as in the human finger; very long where the covering is thick, as the hoof of the horse.

The organ of taste is only a modification of touch, and therefore nothing in the organization is different, but the varieties in structure adapting the tongue for different purposes are numerous; in many animals it answers the purpose of a hand, to bring the food to the mouth, as in many shell-fish, the ant-bear, woodpecker, and camelion. Connected with the tongue are the fauces, which in many animals have peculiarities; in the electric eel, they have a very curious carrunculated irregular appearance; but they are yet more extraordinary in the camel, which has an apparatus to moisten the parts, so as to prevent the painful sensation of thirst, thus adapting the animal to the sandy deserts which it is destined to inhabit; this apparatus consists of a large bag hanging down several inches in the fauces, and attached to the palate, which the animals can at pleasure move up and down, and lubricate the fauces.

The organ of smell is variously constructed, and is more complicated in many animals than in man, as in the lion and sea-cow. The organ of hearing in fish consists of three semicircular canals; but is much more complex in land animals.

The organ of seeing is different in those animals which are formed to see in water, and in those which see in air; it differs again in those which are to see with little or with much light all those peculiarities are illustrated by preparations. The pigmentum of the eye in some fish resembles polished silver; in ruminating animals at the bottom of the eye it has a greenish hue, in the lion and cat kind, a portion of the bottom is white; but, as a general principle, the colour of the pigmentum is the same as the rete mucosum of the skin of the animal, being white in white animals, and black in very dark ones.

After the brain and senses, are arranged the cellular membrane and animal oils, which are followed by the external coverings. These are divided into the different kinds, as hair, feathers, scales, &c. with the rete mucosum, or that membrane which is interposed between the true skin and the scarf-skin, for the purpose of giving the peculiar colour. Added to these are the parts peculiar to different animals, for offence and defence, as spurs, hoofs, horns, stings, and also electric organs. There follow next such peculiar structures as occur in certain tribes of animals, as the air-bladders in fish, &c.

Besides the preparations of themselves in spirits, in a dried state or corroded, so as to give the most accurate ideas of their structure of parts, there is a considerable number of very valuable drawings in this collection to show the progress of different processes in the animal œconomy, together with such appearances as were not capable of being preserved.

This sketch will give an idea, but a very inadequate one, of the system which is comprehended in Mr. Hunter's collection.

It also includes a very large series of whole animals in spirits, arranged according to their internal structure, and many of the most rare specimens of preserved animals in this country, as the camelopardos, guanica, hippopotamus, tapir, argus-pheasant, &c.

There is also a series of sculls of different animals, to show their peculiarities, and skeletons of almost every known genus of animals.

There is a large collection of shells and insects; a prodigious number of calculi of different sorts from the urinary and gall-bladders, the stomach, and intestinal canal; there are likewise the most uncommon deviations from the natural structure, both in man and in other animals, preserved in spirits or in a dried state; the most extraordinary specimens of this kind are, a double human scull perfectly formed, the one upon the top of the other.

To make this collection more complete in every subject connected with comparative anatomy, is added one of the largest and most select collections of extraneous fossils that can be seen in this country.

This museum, the greatest in the world, raised by the industry of an individual in a short life, which would have conferred even an honour on an age, and that uncommonly industrious, was at the death of its owner eagerly sought after by foreign Courts. The king of Spain made an unlimited offer to the family of John Hunter: but the British Parliament wished to secure to this country so invaluable a possession, and twenty thousand pounds is the sum allotted for the purchase of this museum, so honourable to the founder and the nation.

It is deposited in an handsome building belonging to the Corporation of Surgeons, being presented them by Government, and is a record of the vast patience and genius of this extraordinary man.

Let it not, however, lead the enemy to philosophy (for some such characters there are) to object to him on that account Materialism and the Disbelief of the doctrine of a

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EMBLEMS OF IMMORTALITY

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future state. For, however sight, or any other sense, may depend on *mechanism*, still it must not be *confounded* with it. The MIND or SOUL has a much higher origin than that of the perishable frame with which it is at present connected. It is neither *nerve* nor the *electric fluid*. These are only *its agents* in this its incarcerated state.—When the "*silver cord*" is broken, which connects MIND and MATTER together, vitality ceases, the *body* then, with all its artful and numerous vessels, fibres, and nerves, and other exquisite *machinery*, undergoes decomposition, and is turned into its original elements; but the IMMORTAL SOUL, having shaken off this coil, is destined for a new residence; to flourish in eternal youth; to outlive the wreck of elements, and the crash of worlds. It is embodied even in its residence in another world. "Thou fool," says the philosopher and apostle, "that seed which thou sowest is not quickened except it die. And that which thou sowest, is not *that body* which shall be: but GOD *giveth* it *a body* as it hath pleased HIM, and to *every seed* its *own body*.—*So also* the *resurrection* of the dead. The body is sown (in the earth) in *dishonour*, it is raised in *glory*; it is sown in *weakness*, it is raised in *strength*. It is sown a *natural body*, it is raised a *spiritual*. Behold, I shew you a mystery. We shall not all sleep, but we shall all be *changed*; in a moment, in the twinkling of an eye, at the last trump; for the trumpet shall sound, and the dead shall be raised *incorruptible*, and we shall be *changed*. For this *corruptible* must put on *incorruption*, and this *mortal* must put on *immortality*."

Man, therefore, is not what he will hereafter be. What we discover of him here below, is only the *gross foldage* under which he drawls upon the earth, and which he must shortly *cast off*.

Could not the *omnipotent* AUTHOR OF NATURE, who pre-ordained all beings from the beginning, who originally enclosed the *gaudy* and *winged butterfly* in the *chrysalis*, the *plant* in the *seed*, comprise the *spiritual body* in the *animal?*

The *animal body* has no other relation than to this earth. The *spiritual body* will have *enjoyments* which ear hath not heard, nor hath it entered into the heart of man to conceive; *new senses* will disclose themselves, and, by multiplying in an almost infinite degree his perceptions, his sphere will be aggrandized, and he will be equal to superior intelligences.

REVELATION informs us *it will be so*; and the parable of the *seed* is the most expressive and philosophic emblem of this wonderful pre-ordination.

The *senses*, as they will be brought into subjection to the soul, will no longer rule over her. Separated from *flesh* and *blood*, there will remain in her none of those earthly affections which resulted from them. Transported into the regions of light, the human understanding will present no ideas to the will but those of the highest good. It will then have no other than lawful desires, and GOD will be their constant and ultimate end. It will love HIM from gratitude; will fear HIM from a principle of love; and will adore HIM as the *supremely amiable Being*, and as the *Eternal source* of life, perfection, and happiness.

Christians, who believe this doctrine of life, can ye have any dread of *death?* Your immortal spirits continually cleave to matter, and they are indissoluble; being henceforth united to an *imperishable* and *differently organized body*, she looks upon *death* as a happy *transformation*, which, by disengaging the seed from its foldage, will give a new being to the plant. "*O death, where is then thy sting! O grave, where is thy victory!*"

SECTION XXXIV.

ON ANIMAL ELECTRICITY; OR THE CAUSE OF MOTION IN THE VOLUNTARY ORGANS, OR MUSCLES.

Does there appear any principle in all Nature, says our English historian, more mysterious than the union of soul and body, by which the spiritual part possesses such an influence over the material, that it is able to direct the motion of any muscle, or even sometimes a part of a muscle? Were we empowered by a secret wish to displace mountains, or control the planets in their orbit; this extensive authority would not seem more extraordinary or more unaccountable †. An accident, fortunate for philosophy, has thrown, however, some light on this hitherto mysterious subject.

Whilst Professor Galvani, at Bologna, was dissecting a frog, in a room where some of his friends were amusing themselves with an electrical machine, one of them happened to draw a spark from the conductor, as the professor touched one of the nerves of the animal. In an instant the whole body of the frog was shook by a violent convulsion.

The professor was astonished at the phænomenon, and believing it to be owing to his having wounded the nerve; to assure himself whether this was really the case, he pricked it with the point of his knife, without any motion being produced: he now touched the nerve with the instrument as at first, and desired a spark to be taken from the machine, on which the contractions were renewed.

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† Vide Hume's *Essays*. The same observation, in nearly the same expressions, may be found in Voltaire's *Ignorant Philosopher*.

The experiment was repeated a third time, but the animal remained motionless; however, as the ivory handle of the dissecting knife was a bad conductor of electricity, he changed it for a metallic one, and re-excited the movements, which he constantly failed in doing whilst using an electric substance.

After having made a great number of experiments with the electrical machine, he resolved next to make trial of atmospheric electricity. To this end he raised a conductor upon the roof of his house, from which he brought an iron wire into his room, and to this attached metal conductors, connected with the nerves of the animals destined to be the subject of his experiments, and to their legs he tied wires, which reached the floor. Considerable movements were observed in the animals, whenever it lightened. These preceded the claps of thunder, and always corresponded with their intensity and repetition; and even when it did not lighten, the movements took place, whenever any thunder cloud passed over his house.

Having next laid bare the nerve leading to the wing of a duck, the scissars of the operator being under it, whenever any of the company present applied a shilling, or a half crown, to the nerve so disposed, the nerve was agitated by a violent movement, which occurred as often as the shilling or half crown was employed, till the nerve was exhausted of its power, which happened commonly in about 15 minutes.

It was afterwards found, that if an half crown be placed in contact with the under part of the tongue, and a plate of zinc be applied to the upper part, on bringing the two metals into contact with each other, a pungent disagreeable feel, which it is difficult to describe, is produced at the point of the tongue.

And if a plate of zinc be placed between the gums and the upper lip, and a plate of gold be placed in the upper part of the tongue, when the gold is brought into contact with the zinc, the person sees immediately a flash of lightning.

After performing this experiment repeatedly, I constantly felt, says Dr. Monro, the Professor of Medicine at Edinburgh, a pain in my upper jaw, which continued for more than an hour. And in one experiment, after I had applied a blunt probe of zinc to the partition which divides the nose into two nostrils, and repeatedly touched it with a crown piece of silver applied to the tongue, I thereby produced the appearance of a flash of lightning, and several drops of blood fell from that nostril. Dr. Fowler, after making a similar experiment on his ears, observed a similar effect.

The experiment of producing sparks by stroking the back of a cat in frosty weather, readily shews that the electric fluid naturally exists in a very active state in the bodies of some animals. Possibly, says the celebrated Dr. Priestley, the *light* which is said to proceed from animals, as from wild beasts, when they are in pursuit of their prey in the night, may not only arise, as it has hitherto been supposed to do, from the mere friction of their hairs or bristles, but violent *muscular exertion* may also contribute to it. *This light* may, with the electric flashes from their eyes, assist them occasionally to catch their prey; as glow-worms and other insects are provided with a constant electric light for that purpose.

Mr. Hartman having neglected to supply his paroquet with water to wash himself, he observed that its feathers, in a state of dryness, were endued with a proper electrical virtue, repelling one another, and retaining their electricity even a long time after they were plucked from the body of the bird, just as they would have done if they had received electricity from an excited glass tube.

The following is a very remarkable instance of the existence of this fluid in the human frame, and of the ease with which it is put into action Brydone, in his travels, mentions the story of a lady, who, on combing her hair in frosty weather in the dark, had sometimes observed sparks of fire to issue from it; this made him think of attempting to collect the electrical fire from the air, without the assistance of any other electrical apparatus. To this end he desired the young lady to stand on wax, and comb her sister's hair, who was sitting in a chair before her; soon after she had begun to comb, the young lady on the wax darted out sparks of fire against every object that approached her. Her hair was strongly electrical, and affected an electrometer at a considerable distance. He charged a metallic conductor from it, and in the space of a few minutes collected a sufficient quantity of electric fire so as to kindle common spirits, and by means of a small jar, gave many smart shocks to all the company present.

Cavallo also mentions, that he obtained, by means of a small condensing plate, very sensible signs of electricity from various parts of his own body, and from the head of almost every other person on whom he made the experiment.

The celebrated John Wesley relates, that Mrs. Susanna Sewall, in New England, at a certain time of the year, never changed her apparrel without observing a strange flashing of sparks. In the company of several persons, having taken off some of her wearing apparel, and shaking it, sparks flew forth, making a noise much like bay leaves thrown into the fire. They desired Mrs. Sewall one day to put on her sister's garment; and when she put it off, in the evening, it sparkled as her own used to do.

It has often been observed, that when we wear worsted under-stockings, and silk over them, if we chance to draw off the silk stocking in the dark, the bright electric fluid is seen flashing from every part of the worsted under-stocking.

A variety of other curious facts clearly evince, that the electric fire is essentially connected with the animal body, and is continually exerting its influence on it.

The electric fluid, however, is far more conspicuous in the body of the GYMNOTUS, which has the remarkable property of generating and throwing out its electricity much beyond the limits of its own system. I have often, says Dr. Garden, when I have taken hold of the *gymnotus* with one hand, and put the other into the water over its body, without touching it, received a *smark shock*; and I have observed the same effect to follow, when a number of persons joined hands, the person at one extremity of the circle taking hold of, or touching the electric fish, and the person at the other extremity putting his hand into the water over the body of the fish; the shock was communicated through the whole circle as smartly as if both the extreme persons had touched the fish. I am told, continues Dr. Garden, that some of these fish in Surinam river, are upwards of 12 feet long, whose stroke or shock proved *instant death* to any person who had the misfortune to touch it.

Mons. Fermins, in his Natural History of Surinam, published in 1765, also tells us, that making 14 persons grasp each other by the hands, while he grasped the hand of the last with one of his, and with the other touched the GYMNOTUS with a stick, the whole number felt the shock, and he could not prevail on any of them to repeat the experiment*.

Dr. Priestley relates, that the sensation is strongest when the fish is in motion, and is transmitted to a great distance, so that if persons in a ship happen to dip their fingers or feet in the sea, when the fish is swimming at the distance of fifteen feet from them, they are affected by the shock.

Mr. Walsh gives us the following beautiful experiment, to prove that the *gymnotus* is very sensible whether the substances brought near him are proper or not for receiving the electric shock.

The ends of two wires were put into the water of the vessel, which contained the animal; these wires were of some length stretched to their extent, and terminated in two glasses of water placed at a considerable distance from each other. Whilst the apparatus remained in this state, and the circulation was of course *interrupted*, the animal did not prepare to exercise his power, but the instant a spectator, or any conducting substance filled the interval, and rendered the circle complete, it instantly approached the wires, arranged itself, and gave the shock.

The surprising property of the TORPEDO, in giving violent shocks to the person who takes it in his hands, or who treads upon it, was long an object of wonder. For some time it was generally reckoned to be a fabulous history; but at last the matter of fact being ascertained beyond a doubt, *philosophers* have endeavoured to find out the cause.

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* Vandelott makes two species of the *electric eel*, the black and reddish; though he acknowledges that, excepting the difference of colour and degree of strength, they are not materially different.

As an insulated person cannot receive a shock from either of these extraordinary fishes, the identity of this fluid, and the electric fluid, is clearly ascertained.

Mr. Hunter has well observed, says Sir John Pringle, that the magnitude and number of the nerves bestowed on the electric organs of the *torpedo* and *gymnotus*, must appear as extraordinary as their effects; for if we except the important organs of our senses, there is no part, even of the most perfect animal, which, for its size, is more liberally supplied with nerves than the *torpedo:* nor yet do these nerves of the electric organs seem necessary for any *sensation* that can belong to them; and with respect to *actions*, there is no part of any animal, however strong and constant its actions may be, which enjoys so large a portion of them. If then it be probable, that *these nerves* are *unnecessary* for the purpose either of *sensation* or *action*, may we not conclude, that they are subservient to the management of the *electric fluid?*

Mons. Reaumur has also resolved it into the action of a vast number of *minute nerves*, situated in a line under the skin, which by their accumulated force gives a sudden and violent shock. He observes, also, that when these animals have exhausted their electric powers, they submit quietly to every insult; but having by a little rest and time recovered their former force, they then hastily repay the offence.

May not animals have a power, is the conjecture of the celebrated Dr. Priestley, of extracting from the blood the *electrical fluid*; the BRAIN then would be the great laboratory for that purpose; and by means of the NERVES, that great principle, thus exalted, would be directed into the *muscles*, and contract them as *ab extra*.

The ingenious Mons. Valli observes, also, that the size and number of the *nerves*, which are bestowed upon the *electrical organs* of the TORPEDO and GYMNOTUS are truly extraordinary and astonishing.

The nerves of the *muscles* in animals are likewise very large, and their minute ramifications so great, that several physiologists have been led to believe that muscular contractile fibres are the same thing as nervous fibrils.

The blood-vessels of the *electrical organs* are very numerous, follow the course of the nerves, and distribute the smaller branches along with them.

The quantity of vessels expended upon the *muscles* is also prodigious, and they likewise are found to accompany the course and distribution of the nerves.

There exists in *muscles* as well as in the *electrical organs* of the torpedo and gymnotus, cylinders, partitions, and a great subdivision of parts.

Have we not therefore every reason to believe that our *muscles* are so many *electrical organs*, each muscle being as it were a battery, and muscular intumescence and contraction, in consequence of a sort of explosion produced by the animal or nervous electricity* ? According to this

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* I once happened, says Dr. Priestley, to lay a chain near my electric batteries, so as to make it return at a sharp angle, in order to impress the form of the letter *b* upon the table; and observed, that on the discharge, the part of the chain that had been *doubled* was displaced, *and pulled about two inches towards the rest of the chain.* At this I was surprised, as I thought it lay so that it could not slide by its own weight. Upon this I repeated the experiment with more accuracy. I stretched the whole chain along the table, laying it double all the way, and making it return by a very sharp angle. The consequence always was, that the chain was SHORTENED about *two inches*, and sometimes more, *as if a sudden pull had been given it.*

The contraction of a muscular fibre may be *compared*, says the illustrious Dr. Darwin, to the following electric experiment. Let twenty very small Leyden phials, properly coated, be hung in a row by fine silk threads at a small distance from each other; let the internal charge of one phial hypothesis our nervous and muscular systems may be considered, says Dr. Beddoes, as a beautiful machinery, and muscular motion, at least that of animals analogous to man, would be a chemical operation combining *hydrogen* and *azot* with OXYGEN. This hypothesis, though not perhaps capable at present of the strictest proof appears highly probable. It accounts for the perpetual necessity of our imbibing OXYGEN AIR, and enables us to trace the changes undergone by this substance, from the moment it is received, till the moment it is expelled. During the contraction of the muscles, OXYGEN combines with the elements above mentioned into *water* and *various salts,* among which the *marine* and *phosphoric acids* deserve particular notice. *In this state* it is taken up by the *absorbents,* and afterwards *exhaled* or *excreted.* Hence the necessity for OXYGEN AIR in the blood for *muscular action,* and hence the reason why *motion languishes,* whenever *this principle is scantily supplied by the lungs.*

A very delicate experiment was made by Dr. Mayow, in the last century. A dog that was *panting* and *breathing* deeply, on receiving *arterial*, that is, *oxygenated* blood into one of his veins, instantly began to breathe so *calmly* that his respiration was scarce *sensible.* The animal here receiving from an *unusual source* the sustenance which is probably expended by violent muscular action, it became *therefore* no longer necessary to inhale it *rapidly**.

The paviers always make a deep inspiration before they strike down the stones, whereby they acquire a large pro-

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be positive, and of the other negative alternately; if a communication be made from the internal surface of the first to the external surface of the last in the row, they will all of them instantly *approach* each other, and thus SHORTEN a line that *might connect them together like a muscular fibre.* Vide ZOONOMIA, p. 61.

* Vide Sect. XVIII, on Transfusion of Blood, p. 152.

portion of *oxygen*, and make a loud and forcible expiration, to admit of a larger portion of this principle to be expended in muscular motion. Dr. Beddoes having for some time inhaled *vital air*, says " he not only felt himself warmer, " but certainly more *disposed towards* and *capable* of MUS- " CULAR EXERTION."

SECTION XXXV.

HEAT PRODUCED BY EXERCISE.

It was shewn in the last section, that when muscular intumescence took place, the *vital air* in the blood was decomposed, forming certain chemical combinations, productive of the *vital flame*.

If I walk slowly along, for the space of a quarter of a mile upon even ground, my *breathing* and *pulse* are but little accelerated, and the *heat* of my body remains nearly the same as before. But if I walk at the same pace, and for the same distance, up a *steep hill*, or bearing a *heavy burthen*, my *breathing* becomes *short* and *full*, and my *heart* beats *strong* and *quick*, and the *heat* thrown off from my body corresponds with these increased internal movements.

It is natural to ask, what is the cause of this *difference*, when the *space*, the *speed*, and the *actual movement* of the muscles, are the same? It must certainly arise from the *quantity* of *nervous electricity* transmitted from the BRAIN to the muscles in the *latter case*, where the body was *raised* up hill, or where a *weight* was carried, being *much greater* than when the body is *only moved*, without being lifted up, or without any additional weight upon it. For though the *motion* of the muscles be the *same* in both cases, yet the *increased* weight to be moved, required the *nervous exertion* to be much *greater* in the latter instance than in the former; and therefore the *will*, or *determination of the mind*, propelled a *greater quantity* of *nervous electricity*, from the BRAIN to the *muscles* employed.

To the increased demand on the system of OXYGEN AIR, to be *decomposed* by the *nervous electricity*[*], the accelerated *respiration* must be attributed; and from the increased quantity of OXYGEN AIR in the blood, we can account for the improved *digestion*[†], and a more rapid *circulation*; and from all these causes, concurring with the *electricity* of the nerves, we are able to see clearly the reason of the increase of the VITAL FLAME.

If an animal, a man, for instance, in good health, be exposed to a *temperate air*, in a state of *rest*, the quantity of *vital heat*, generated by the continued attractions of *oxygen* going on in the body, will be sufficient, with a certain quantity of clothing, for maintaining the temperature of about 97 degrees, by which the solids receive their natural stimulus, the fluids retain their proper fluidity, and all the functions of life are duly performed, and a sufficient quantity abounds to carry off the perspirable fluid. If a man, exposed to a *frosty air*, continues at *rest*, the principles in his body attractive of *oxygen*, cannot generate a sufficient quantity of *vital heat* to keep every part of the body at its right temperature; because the coldness of the surrounding medium carries off *the heat* faster than *they* can produce it; consequently the solids and fluids of the extremities, and at the surface of the body, will become frigid, and the fibres torpid, and the death of the extreme, and lastly of the vital parts, ensue. But, on the contrary, when a man exposed to a *frosty air,* perceives the coldness, and torpor, arising from his body being deprived of its heat, faster than the principles in his body attractive of *oxygen* can furnish it; if he throws the *voluntary muscles* into action, the quantity of *heat* generated by the *nervous electricity,* will be sufficient to warm every part, and recover and maintain the natural temperature; although the air shall continue to withdraw rapidly the *vital heat* from the surface of the body.

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[*] The *oxygen air* thus procured to the blood from the want of the system, is said to proceed from the *vis medicatrix naturæ*, and by others from association or sympathy. Thus the call of the stomach for food after a fever does not arise from the stimulus of the gastric juice, but from the *want* of the system.

[†] Vide Sect. XXX. on the Balance betwixt Respiration and Digestion.

Some very pleasing experiments were made by the ingenious Dr. Peart, which prove that *partial exercise* conveys *a glow* over the *whole body.*

I. EXPERIMENT.

I put my hand, says he, first into cold water at 56 degrees of temperature. After fifteen minutes I withdrew it, and found the temperature of the water raised to 65.

It had gained, therefore, in fifteen minutes, 9 degrees of heat.

II. EXPERIMENT.

The same day I put my hand as before, but instead of keeping it, and my body, in a state of perfect rest, I threw many of the voluntary muscles into action, and in fifteen minutes the water at 56 degrees was raised to 73.

Here it had gained 17 degrees of heat.

III. EXPERIMENT.

To prove that the exertion of any set of muscles affects the quantity of heat generated within, and thrown off from the whole body, I introduced my hand into the same quantity of water, and at the same temperature as in the first experiment, and I pushed my feet against a large book-case, firmly fixed by its own weight, and my arms were forcibly stretched out. By the exertion of these few muscles only, without any motion of the fibres, so much of the *electric fluid* was transmitted to these parts, and so much *heat* disengaged, that its *stimulus* extended over the *whole body*, and the water in fifteen minutes rose in consequence to 14 degrees, that is, five degrees more than when the body was in a state of perfect rest.

The same is proved, though not quite so philosophically, by the vulgar mode of warming the body by throwing the arms across; or by the more elegant, but partial, exercise of what are called dumb bells, or by dancing.

SECTION XXXVI.

ON THE NECESSITY OF USING EXERCISE.

To shew the absolute necessity of EXERCISE in *cold climates*, I must beg leave to relate the botanical excursion of Sir Joseph Banks, Dr. Solander, and others, on the heights at *Terra del Fuego*. Dr. Solander, who had more than once crossed the mountains which divide Sweden from Norway, well knew that *extreme cold* produces a torpor and sleepiness almost irresistible, he therefore conjured the company to keep always IN MOTION, whatever pain it might cost them, and whatever relief they might be promised by an inclination to rest:—"*Whoever sits down*, says he, *will sleep*; *and whoever sleeps, will wake no more*." Thus, at once admonished and alarmed, they set forward; but while they were still upon the naked rock, and before they had got among the bushes, the cold was so intense, as to produce the effects that had been most dreaded. Dr. Solander himself was the *first* who found the inclination, against which he had warned others, irresistible; and insisted upon being suffered to lie down Sir Joseph Banks intreated and remonstrated with Dr. Solander in vain: down he lay upon the ground, though it was covered with snow; and it was with great difficulty that his friend kept him from *sleeping*. One of his *black servants* also began to linger, having suffered from the cold in the same manner as the Doctor. Partly by persuasion, and partly by force, the company made them go forward. Soon, however, they both declared " they would go no farther." Sir Joseph Banks had recourse again to expostulation, but these produced no effect: when the black was told that if he did not go on he would in a short time be frozen to death; he answered, *that he desired nothing so much as to lie down and die.* The Doctor did not so explicitly renounce his life; he said he would go on, but that he must first take some " *sleep*," though he had before told the company that " *to sleep was to perish.*" They both in a few minutes fell into a profound sleep, and after five minutes Sir Joseph Banks happily succeeded in waking Dr. Solander, who had almost lost the use of his limbs, and the muscles were so shrunk, that his shoes fell from his feet; but every attempt to relieve the unfortunate black proved unsuccessful.

The ten thousand Greeks in their memorable retreat in passing through Armenia were exposed, says Xenophon, to a contest still more dangerous than the enemy, in which neither skill nor valour could avail. The snow fell in such quantities during the night as completely covered the men with their arms. Their bodies when freed from the snow were benumbed and parched with the piercing coldness of the north wind. Many slaves and sumpter horses perished, with about thirty soldiers. It was observed that those died who did not use sufficient exercise. Xenophon came up to several soldiers who were lying down upon the snow, insisting upon their marching on; but although they had traversed such a great extent of country, and had the prospect of reaching their homes, such, says the historian, was the inclination to remain quiet, that many refused to move until their general threatened or inflicted violent punishment on them, even though they themselves knew it to be the only remedy against their distress. As the severity of the weather still continued during the remainder of their march through Armenia, several soldiers lost their sight by the glare of the snow, and their toes and fingers by the intenseness of the cold. The eyes, says Xenophon, were best defended by wearing something black before them, and the feet were preserved by *constant motion* in the day, and by stripping them bare during the night, and when frost-bitten, the friction was obliged to be with snow.

It was a principle among the ancients, that *acute diseases* are from heaven, and *chronical* from ourselves; to die, says Dr. Johnson, is the fate of man, but to die with *lingering anguish* is generally his own folly. *Inactivity* never fails to induce an universal relaxation of the contractile fibres. When these fibres are relaxed, neither the *digestion*, the *circulation*, nor the *peristaltic motion*, can be duly performed.

It is absolutely impossible to enjoy health, where the *perspiration* also is not duly carried on; and that can never be the case where *exercise* is neglected.

The necessity of *action* is not only demonstrable from the fabric of the body, but evident from the observation of the universal practice of mankind, who for the preservation of health in those, whose rank or wealth exempts them from the necessity of lucrative labour, have invented sports and diversions, though not of equal use to the world with agricultural employments, yet of equal fatigue to those who practise them, and differing only from the drudgery of the husbandman, as they are acts of choice, and therefore performed without the painful sense of compulsion. The huntsman rises early, pursues his game, through all the dangers and obstructions of the chace, swims rivers, and scales precipices, till he returns home, no less harassed than the soldier, and has perhaps sometimes incurred as great hazard of wounds or death: yet he has no motive to excite his ardour; he is neither subject to the commands of a general, nor dreads any penalties for neglect and disobedience; he has neither profit nor honour from his perils and his conquest, but toils without the hopes of mural or civil garlands, and must content himself with the praise of his tenants and companions.

But such is the constitution of man, that *labour* may be styled its *own reward*; nor will any *external excitements* be requisite, if it be considered *how much happiness* is *gained*, and *how much misery escaped*, by frequent and violent agitation of the body.

The desire of *exercise* is *coeval* with life itself. Were this principle attended to, many diseases might be avoided. But, while *indolence* and *sedentary* employments prevent two thirds of mankind from either taking sufficient exercise themselves, or giving it to their children, what have we to expect but disease and deformity? The *rickets*, so destructive to children, called by the *French* the *English disorder*, never appeared generally in Great Britain till manufactures began to flourish, and people, attracted by the love of gain, left the country to follow *sedentary* employments in great towns *.

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* Dr. Buchan.

Every animal makes an early use of its organs of motion; and many young creatures, even when under no necessity of moving in quest of food, cannot be restrained without force. This is evidently the case with the calf, the lamb, and the kitten. If these harmless animals were not permitted to *frisk* about and *take exercise*, they would soon die, or become diseased; and so strong is this *principle* implanted in the human breast, that a healthy youth can hardly be kept from exercise. This love of motion is surely a strong proof of its *utility*. Nature implants no disposition *in vain*. It seems a catholic law throughout the whole brute creation, that no creature, without *exercise*, shall be able to find subsistence. Every creature, except man, takes as much exercise as his nature requires. He alone sleeps till late in the morning in beds of down, and often lolls all day in easy chairs, and deviating from the great law of his Creator, he suffers accordingly.

If fashion must prevail, and young children be sent to *crowded* schools, we would recommend it to their teachers, as *they value the lives of those entrusted to their care*, and *the account they must one day give*, that they would allow their pupils a sufficient time to *run* and *frisk* about, instead of keeping them *hour after hour* in close and irksome confinement, which subjects them to a dreadful train of disease, flatulence, indigestion, colics, worms, &c. &c. and hinders them hereafter from being *happy* and *useful* members of society. From *this criminal folly*, says the emphatic Dr. Johnson, proceed most of those pains which wear us away slowly with periodical tortures, and which, though they sometimes suffer life to be long, condemn it to be useless, chain us down to the couch of misery, and mock us with the hopes of death.

Certainly man was never designed to be sitting all day *cross-legged* on a board. The *master*, who denies a sufficient time for *exercise* to those unhappy beings, whom PROVIDENCE has subjected to his will, has a dreadful reckoning to make, when each individual shall receive from the *same measure* he has meted out to others.

Were sedentary employments intermixed with a due quantity of exercise, they would never do much hurt. It is constant confinement that ruins health. A man will not be injured by sitting at his work three or four hours at a time; but if he be *obliged*, by an *unfeeling master*, to sit eight or ten, he will soon be said to drag on life instead of enjoying it. Weak and ailing, he will languish out a few miserable years, and at last sink into an untimely grave.

Weak fibres are the constant companion of *inactivity*. Nothing but daily *exercise* in the *open air* can brace and strengthen the powers of the *stomach*, and prevent therefore an endless train of diseases, which proceed from a relaxed state of that organ. We seldom hear the active or laborious complain of what are called *nervous diseases*; these are reserved for the sons of idleness. Many have been completely cured of these disorders by being reduced, from a state of opulence, to labour for their daily bread. This plainly points out the sources from whence *nervous diseases* flow, and the means by which they may be prevented.

Dr. Cheyne, in his excellent Treatise on Health, says, that the weak and valetudinary ought to make EXERCISE *a part of their religion*. We would recommend this, not only to the weak and valetudinary, but to sedentary artificers, shopkeepers, studious persons, &c. &c. Such ought to consider *exercise* as necessary *a duty* as to *take food*; and this might be usually done without any great loss of time or interruption to business.

Every man, in short, should oblige himself by some absolute rule to engage in *daily exercise*. *Indolence*, like other vices, when indulged, gains ground, and at length becomes agreeable. Hence many who were fond of *exercise* in the early part of life, become quite averse to it afterwards. Diseases are engendered destructive of the resolution of the mind. Nauseous drugs are had recourse to. The stimulus at the stomach spreads its influence for a time over the whole body. It at last loses its efficacy, or becomes prejudicial, and the *pale, flatulent,* and *bloated hypochondriac,* flies from physician to physician, none of whom dare advise him EXERCISE, which he is averse to, and says he cannot take, and he falls at last into diseases of a more serious aspect, and dies of spasm in the stomach, or dropsy, or asthma, or jaundice, or a cough with mucous expectoration, or palsy, or hæmoptoe, or some other disease that either arises from, or is always *engrafted* upon, a *weak* and *debilitated frame.*

> ——— Weariness
> Can snore upon the flint, when resty sloth
> Finds the down pillow hard.
>
> SHAKSPEARE.

I shall conclude this long but *useful* essay with some beautiful lines from Armstrong, whose poem, entitled *the Art of Preserving Health,* might have possibly promoted the *discoveries* of the late Dr. Brown.

> The shades descend, and midnight o'er the world
> Expands her sable wings. Great NATURE droops
> Through all her works. How happy he whose *toil*
> Has o'er his languid powerless limbs diffus'd
> A *pleasing lassitude.* He not in vain
> Invokes the gentle deity of dreams.—
> *By toil subdu'd,* the warrior and the hind
> Sleep *fast* and *deep;—their active functions soon*
> *With generous streams their subtle tubes supply.*
> Ere morn *the tonic irritable nerves*
> Feels the fresh impulse, and awake the soul.

SECTION XXXVII.

OF GANGLIONS.

Besides progressive motion, the various movements of the hands, and other parts of animal bodies, which are performed by *muscles* curiously fashioned for each purpose and wisely distributed, there are *other motions* that, on the contrary, have little or no dependance on our inclination. Of this kind are the actions of the heart; the circulation of the blood; the motions of the stomach, and intestines; the progress of the chyle to the subclavian vein; the movement of the various secreted liquors, such as the gall, the saliva, &c. These, together with the lungs in respiration, have received the denomination of VITAL OR INVOLUNTARY MOTIONS, because they go on without any conscious exertions of the intellectual principle.

If such a variety of nice and complicated movements had been left to the determination of the will, it had occupied every moment of our thought, and stopped during sleep, when consciousness is totally obliterated. We therefore here clearly discern the goodness of the ALMIGHTY, which has given man the absolute direction of no movements, but what are easily performed, and which contribute also to health and pleasure.

Physiologists were long perplexed to account *how parts supplied with* NERVES *could be insensible*; and *how, though all the nerves terminate in the common sensorium or brain, over some organs the influence of the will extended, whilst the motions of others were* INDEPENDENT *of that principle.* They allowed the propriety of the final cause, and referred it to the wisdom of GOD primarily, whereas *philosophy* should look for *second causes* †, which demonstrates the same goodness, with still greater power, in our beneficent CREATOR.

The solution of this difficulty was reserved for the glory of the present age. The GANGLIONS, which are hard and callous bodies attached to those nerves which supply the organs which have involuntary motion, did not indeed escape the all-prying eye of anatomy: but their *uses* were long wholly unknown. Conjectures were indeed formed that they were muscles capable of contractions, by which the nervous spirit was accelerated and impelled forwards: but they have been since found, from the experiments of the illustrious De Haller, incapable of such contraction, being wholly devoid of irritability. They have been represented as little brains to supply that afflux of nervous fluid which the incessant motions of the organs to which they went seemed to require. Repetition and authority gave considerable weight to these conjectures, and we therefore are the less surprised that Dr. Johnson, the ingenious and learned discoverer of their *real use*, should complain:

" It requires a long series of years for the admission of " *new* truths. The period cannot be limited to thirty or " forty years.

" It depends on circumstances peculiar to the age, the " subject, and the author's situation: and mine has no " peculiar advantages.

" It is thirty years since my early thoughts on the *uses* " of the GANGLIONS of the nerves was communicated to " my correspondents Dr. Whytt and Baron de Haller; and

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* Aristotle, Cicero, Galen, Bacon, Boyle, Newton, and Locke, all concur in allowing that the *last link* in the chain of natural causes terminates at the throne of GOD.

" twenty years since, on maturer reflection, I published an " account of this *discovery* to the world.

" My opinion has been silently attacked, and as silently " adopted, without any explicit acknowledgment of the " author, or any direct quotation from his work. Several " of the objections which I have answered, were commu- " nicated in a corespondence with which I was honoured " by Baron de Haller: and I have reason to think, " from a letter afterwards received, my answers were " satisfactory.

" My ideas were received by Dr. M'Kettrick, and my " work ingeniously analyzed by the celebrated Tissot. I " say nothing of the private, and perhaps partial, testi- " monies of my correspondents.

" *But before truth, in its silent or disputed march, has* " *roused the attention of the indolent, converted the super-* " *cilious, subdued the interested and obstinate, and reached* " *the ears of all, an age has passed away.*" *!!!*

GANGLIONS, as we before observed, are attached wholly to nerves which supply the organs which have *involuntary motion*, and being NON-ELECTRIC BODIES†, *are the* CHECKS *which prevent our volitions from extending to them*‡, *and also sensation from reaching the common sensorium.*

The motions of the largest masses, and the most minute particles of matter, all performed with the same order and ease, and regulated by laws surprisingly simple and extensive, penetrating the inmost recesses of bodies, and extended throughout the universe, evince the direction of an OMNIPOTENT ALMIGHTY POWER actuating the whole.

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† If you stimulate any where a nerve *not* supplied with GANGLIONS, all the irritable fibres will be thrown into a state of action through the whole extent of the minute ramifications of that nerve: but, on the contrary, stimuli do not affect the heart, intestines, &c. when applied on the nerves *above* the GANGLIONS, but acting just *below* them, these organs are instantly strongly affected.

‡ In violent fits of passion the accumulated electric fluid of the nerves however passes these barriers, and the vital organs are immediately in agitation, and sometimes death ensues.

In every part and operation of Nature, the fitness of things to one another, and their subserviency to the best ends, and to the use and felicity of intelligent beings, point our the consummate wisdom and goodness of one GREAT ARTIFICER, one ORIGINAL MIND.

Sole giver of life, HE inspires with animation the meanest insect, and most abject reptile, no less than the more perfect and nobler animals, and by HIS wisdom guides them all to the several ends of their existence.

Every thing, in fine, on earth and in the heavens, manifests and presents HIM to us; and in the wonders of the lowest, as well as the most magnificent of his works, the understanding with adoration traces the perfections of a CREATOR, who is not far from any one of us, for "*in his image created he man*," which can relate only to mind.

The mechanism of our body, the connexion and subserviency of all its parts to a common purpose, the exquisite contrivance of its organs, consisting of such various minute vessels, interwoven with wonderful art, have led anatomists in all ages to acknowledge an infinite wise and powerful MAKER. Among the most precious remains of antiquity, are those commentaries of Galen written on the uses of the several parts of the human body, as hymns and offerings of praise to the great CREATOR.

Is it, indeed, otherwise conceivable how such consistency and harmony could have taken place in the different parts of our wonderful frame? How they could have so exactly fitted to each other, and to the exterior objects, which have an evident relation to them, and the system they compose? Could the bones*, which in all amount to four hundred, and the muscles, which are still more, and are each so well disposed for motion, be adjusted without a superior knowledge in mechanics? The eye, so admirably adapted to light, and appropriated to vision, was it formed without a knowledge of optics? Or the ear without the science of sounds? Even our inclinations and passions, those sources of so much apparent ill, are, by the DEITY, providentially rendered the means of our preservation, both as individuals and a race; and the selfish and social affections, like centripetal and centrifugal forces, conduct us with proper force to the ends intended by our MAKER, to be produced by them. Yet the love of life and all its enjoyments, the fear of death and all its dreadful harbingers, and the social affections and all its endearments, would not have been sufficient security for our carrying on the *vital motions*, with that constancy and uniformity necessary to the preservation of life, if, thus engaged, these motions had depended upon our will and choice, which is produced by the interposition of *ganglions*†.

Reason would have deliberated concerning them with too much slowness, and volition would have executed them often with a dangerous and fatal caprice. For, if the heart had been subjected to the soul's authority as much as the voluntary muscles are, if its motions could have been suspended or stopt with the same facility, death would then have cost us no painful pang: and, whenever the body was tortured with disease, and the mind in anguish from grief or disappointment, a remedy so easily applied might have been too frequently resorted to, and yet more unfortunate beings might have rushed uncalled into the presence of HIM who stationed us for the wisest reasons here on earth.

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* Vide the Plate, GALENIS CONVERSIO, *The Conversion of Galen.*

† Vide Note ‡ page 332.

The preservation of life therefore greatly depends upon our *vital motions* being entirely subject to the wise government of the Author of our lives; who charges HIMSELF with the immediate care of them, and of us.

All this, when attentively considered, must affect us with a sense of GOD's goodness; who, respecting the imbecility of man's nature, hath been pleased, by appetites and passions, to excite him to acts of self-preservation; where the violence of these might have been hurtful, no less than the slowness and instability of reason, hath taken our safety under his more immediate direction. To attribute contrivances like these, and even understanding itself, to unintelligent causes, rather than to the all-wise PARENT OF NATURE, seems an incomprehensible perversion of reason and philosophy.

That mind must be strangely prepossessed and bewildered with false science, which rather seeks for the cause of these involuntary motions, in dead matter, organization, chance, necessity, something that, without knowledge or power, acts wisely and powerfully, than in *the great Fountain of power, wisdom, and animation.*

If chance could be supposed to produce a regular determined action, yet it is beyond the highest degree of credulity, to suppose it could continue this regularity for any time. But we find it remains through life independent of our will; and the same incessant vital actions have been carried on from the commencement of the world. It is thus that the sun's influence upon the earth hath ever been regular. The production of trees, plants, and herbs, hath ever been uniform. Every seed produces now the same fruit it ever did. Every species of animal life is still the same.—Could CHANCE continue *this regular arrangement?* Could any thing continue it but the hand of an OMNIPOTENT CREATOR?

SECTION. XXXVIII.

OF VISION.

When the sun rises on the face of the earth, *all nature* seems to have received *a new creation.* What *majesty!*—What *splendour!*—What *beauty!*

We will attempt, in as familiar a manner as possible, to explain to the attentive reader, *the nice mechanism* by which the sight is thus capable of communicating to the mind these *lively*, *varied*, and *abundant perceptions.*

In relation to the following law, "*that the rays of light are refracted* (or turned inwards) *according to the density of the medium through which they pass,*" our eyes consist of 3 *distinct humours* of *different densities*, each lodged in a transparent capsule, viz.

1. The EXTERNAL, or AQUEOUS;
2. The CENTRAL, or CRYSTALLINE; and
3. The INWARD, or VITRIOUS.

Because light is subjected also to another law, the law of *reflection*, a DARK MEMBRANE lines the whole of the inside of the globe.

The OPTIC NERVE expands itself over the concave bottom of this darkened sphere, whose fibres, in a collected body, terminate obliquely * in the brain.

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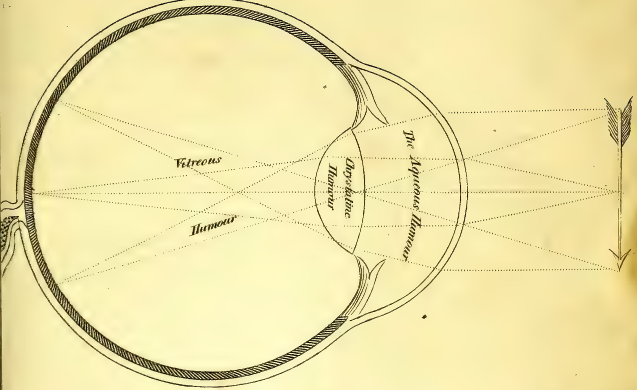
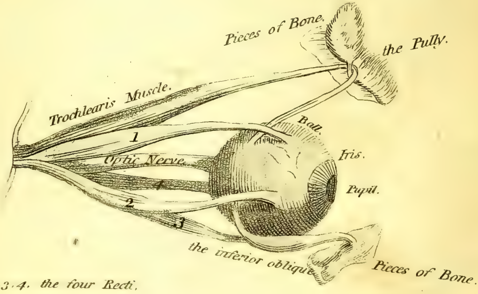
* This might be adduced as a beautiful illustration of the beneficent intention of THE DIVINE ARCHITECT. A vein and artery accompany this nerve, so that when an object strikes upon it, sight is prevented. From the





1, 2, 3, 4. the four Recti,

or straight Muscles.

London, Pub. by Sherwood, Neely & Jones, 1813

At the fore part of the eye there is, as it were, a *partition,* in the center of which a round orifice, called the PUPIL †, is seen, which contracts or dilates itself, to admit of more or a less degree of light, by means of the muscular fibres of the IRIS or UVIA ‡.

Six muscles * are placed behind, so as to turn this beautiful and useful organ on every side.

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obliquity of the entrance of the optic nerve this does not often happen, but may be made to appear, if you form a dark spot on a piece of paper, and shutting one eye, turn this paper about, until the spot strikes on the trunk of the vein covering the optic nerve, when it will immediately disappear.

† This is the *small black circle* in the middle of the eye.

‡ Called *uvia,* from its supposed resemblance to a grape, being usually grey or black. This part is surrounded *externally* by the white of the eye, and *internally* by the pupil. The iris or uvia of a greyhound being put into an alkalescent mixture by Dr. Haighton, the *longitudinal fibres* were rendered visible. These *sympathize* with the optic nerve: for in gutta serena, or decay of energy in that nerve, the pupil remains unaltered in dimensions, however the light may vary. The *sympathy* of parts was before shewn, when discoursing on the synchronous action of the opposite sides of the heart, and is also displayed, when we irritate the nostrils, and excite into action the muscles of expiration, or when exciting the stomach by an emetic, the abdominal muscles, to favour each rejection, are thrown into convulsive efforts.

* The four right muscles arise near together from the bottom of the orbit, where the optic nerve enters, which they surround. The one lifts the eye directly upwards, another turns it downwards, a third draws the sight towards the nose, and the fourth turns it the contrary way. They terminate each in a broad, flat, and very white tendon, which covers all the fore part of the eye, up to the circle of the *cornea* (or outer convex capsule of the aqueous humour); and their white and shining tendons form that enamelled-like part which surrounds the coloured circle, and which is, from its colour, named *the white of the eye,* or the *tunica albuginea,* as if it were absolutely a distinct coat.

So perferctly balanced are these muscles, that if they act all at once the

Thus have we a perfect *camera obscura*, with its different lenses; and the image painted in the darkened chamber of the eye (owing to the reflection of the rays of light from the objects around), by affecting the optic nerve, presents to the mind the varied and agreeable impression.

Should it be inquired, " *in what way* the optic nerve conveys the image of the objects around; and whether this arises from *vibration*, or *the motion* of *some fluid ?*" The answer is, it must be confessed, of very difficult solution. But it seems highly improbable that a *soft inelastic cord*, like a nerve, can *vibrate*, and no *inert heavy fluid* can *equal the quickness of perception.*

We are then induced, says the celebrated naturalist, Bonnet, to admit that there is a subtle fluid in the nerves, whose tenuity prevents our seeing it; and which serves alike for the propagation of sensible impressions, as muscular motion. The *instantaneousness* of this propagation, and *some other phenomena*, indicate that there is *a certain analogy* between *this fluid* and the *electric fluid* *.

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eye is immoveably fixed. So that sometimes in an operation, the eye is found more firmly set than it could be either by instruments or the finger.

The two oblique muscles deserve also particular attention. The inferior oblique arises from the orbit, and obliquely descends into that cavity to be inserted under the eye-ball; and the superior oblique, on the contrary, arises along with the recti muscles, but sends forth a long tendon, which passes through a ring near the nose, and by this beautiful contrivance, it gets inserted into the upper part of the eye-ball. They project the eye forward, as when we strain to see distant objects.

Brutes have *another muscle* not found in our eyes. A surgeon attempting to extract the cataract from the eye of a blind horse, discovered this by accident, for as soon as the eye was touched, it receded deep into the head. This could be effected only by this *seventh* muscle; which therefore seems to be provided for defending the eye, by drawing it thus into the orbit, in creatures who have no hand, like us, to skreen the eye upon the approach of danger.

* Vide Sect. on *Muscular Motion*.

As we know, indeed, that a sixth part of the whole mass of blood is driven to the brain from the heart in an *oxygenated* form, and quickly returns thence *unoxygenated* †, and is as speedily supplied by fresh *oxygenated* blood, it was attempted to be proved that this quantity of blood, when passing into so small an organ as the brain, could not be intended by frugal NATURE solely for nourishment, and the generation of vital heat, but most probably gave out its *oxygen* to be formed by the action of the brain into the *electric fluid.*

As *the nerves* of sight, and the other organs of sense, terminate in the BRAIN, we have the highest reason to believe that the SOUL is seated there.

A substance, therefore, indifferent to motion and rest, is related to a substance that thinks, and though unagitated by external impression, can generally at will regain the former connexion. From this surprising bond there springs a reciprocal commerce between two distinct beings, a kind of action and reaction, which constitutes the life of organized sentient beings.

The brain may therefore be compared to a *carte blanch,* receiving every impression; and to a *cabinet,* wherein the different portions of the universe are painted in miniature, and may be drawn out at pleasure.

SECTION XXXIX.

OF HEARING.

As we saw different humours in the eye in relation to the laws of light, so we find a no less complicated structure of the ear in reference to the vibrations of the air.

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† Vide Sect. on the *Brain.*

The uses, however, of the several parts forming the ear is not so well understood: but it behoves us, in contemplating the work of THE CREATOR, not to question the utility of any part; but to say, we find it here in this particular form, and therefore it must have its use.

The tremulous motions of the air are first received by the external ear. In men this part is much flatter than in brutes, but formed with certain folds, or inequalities, constituting a kind of winding passage for the air into the canal, which leads to the internal part of the ear.

This CANAL by its form would probably invite insects to make a lodgment in it, were it not defended by a tenacious and bitter substance, called the wax of the ear. But in birds, whose organs of hearing are sufficiently defended, no such secretion is observed.

Through this canal the pulsations of the air are conveyed to a membrane, called *membrana tympani*, stretched across it, and dividing the *external*, from what is called by anatomists, the *internal ear*.

From the tympanum, or drum, is an opening into the mouth. On one side of this passage, called *the Eustachean tube*, there is a cartilage, to which there is affixed a muscle, by which the passage may be varied, just as the muscular fibres of the uvia vary the dimension of the pupil for the admission of light. This opening is of so much importance towards hearing, that those who are in some measure deaf, are generally observed to open their mouths when they listen, whereby the vibrations of the air have a freer passage to the tympanum *.

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* The charming contrivance for preventing the food from passing into the wind-pipe by means of a flexible covering, was before observed, and we may remark here a no less kind intention in PROVIDENCE towards man in furnishing him with *the uvula*, which, as the food is passing into the œsophagus, is drawn back, and closes the opening into the nose and

Within the tympanum are lodged *four small bones* subservient to the office of hearing. These communicate with certain *bony* and *winding cavities* †, lined on their inside with *nervous filaments*, which go to the brain by a common trunk.

It is generally believed, that the *tympanum* of the ear vibrates mechanically, when exposed to audible sounds, like the strings of one musical instrument, when the same notes are struck upon another. Nor does this opinion seem improbable, as the muscles and bones of the ear seem adapted to increase or diminish the tension of the tympanum for the purposes of mechanical vibrations.

But it appears from dissection, that *the tympanum* * is not the immediate organ of hearing, but that like *the*

Eustachean tube. Animals who are prone, not being subject to have any of their aliment pass through their nose, want therefore this defence.

† To wit, the *vestibulum, semicircular canals, and cochlea.*

* The situation of the *membrana tympani* is nearly horizontal in men and in brutes, which is the best position to receive sounds reverberated from the earth. In them it is *concave* outward; but in birds it is *convex* outward, so as to make the upper part of it nearly perpendicular to the horizon, which is best fitted for receiving sounds in the air. This membrane does not entirely close the passage, but has, says Cheselden, on one side a small aperture covered with a valve. I found it, says he, once half open in a man that I dissected, who had not been *deaf;* and I have seen a man smoke a whole pipe of tobacco through his ears, which must go from the mouth, by the passage of the Eustachean tube, through the tympanum; yet this man *heard* perfectly well. These cases occasioned me to break the tympanum in both ears of a dog, and it did not destroy his hearing, but he was much shocked at any loud sounds. In very young children I have always found this membrane covered with a *thick mucus,* which seems kindly provided for them, to prevent loud sounds from affecting them too much. A gentleman well known in this city, having had *four* children born deaf, was advised to lay blisters behind the ears of the next children he might have, which he did to *three* which were born after-

humours ef the eye, it is only of use to *prepare* the object for the immediate organ. For *the auditory nerve* is not spread upon the tympanum, but upon the *vestibulum,* and *cochlea,* and *semicircular canals* of the ear; while between the tympanum and the expansion of the auditory nerve, the cavity is said by Dr. Meckel, to be filled with *water* ; as he had frequently observed by freezing the heads of dead animals before he dissected them ; and water being a more *dense fluid* than air, is much better adapted to the propagations of vibrations.

I shall not expatiate on *these recluse parts* ; only there is one special contrivance of the nerves ministering to this sense of hearing, which I think ought not to be passed by. One of the branches of the auditory nerves is distributed

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wards, and every one of these heard perfectly well. It seemed not unreasonable to suppose that too great a quantity of this mucus upon the drum, or the deposition of coagulable lymph thrown out by inflammation, might be the cause of deafness in the four children, and that the discharge made by the blisters in the three latter cases, was the cause of their escaping the same misfortune. From these, and other like cases, it may be concluded, that the *membrana tympani,* though useful in hearing, is not the seat of that sense; and if any disease in that membrane should obstruct the passage of sounds to the internal parts of the ear, which are the seat of that sense, an artificial passage through that membrane might recover hearing, as the removing the *crystalline humour,* when that obstructs the light, recovers sight. Some years since a malefactor, who was deaf, was pardoned on condition that he suffered this experiment. As soon as this was publicly known, Mr. Cheselden, the lecturer on anatomy and surgery of St. Thomas's Hospital, was hooted and insulted in the streets, and having entered the theatre, the play was arrested by the cry of DRUM ! DRUM ! and he was obliged to leave the theatre, so violent at all times has been the indignation against men, who are inclined, from a philosophic conviction of truth, to *innovate,* or rather I might say, to *improve* the routine of things, and he was constrained by the public voice to desist from the attempt; and it is probable that the world will lose for ever the benefits that might have resulted from this experiment!

partly to the muscles of the *ear*, partly to the *eye*, partly to the *tongue* and instruments of *speech* *, and inosculated with the nerves that go to the *heart* and *breast*. By which means there is an admirable and useful *consent* between these parts of the body ; it being natural for most animals, upon hearing any strange sound, to erect their ears, to open their eyes, and to be ready with the mouth to call out, or utter what the present occasion shall dictate. And accordingly it is very common for most animals, when suddenly surprised in sleep with any loud noise, presently to shriek and cry out, and display a great palpitation of the heart.

Hearing is a sense much more necessary to man than to animals. With these it is only a warning against danger, or an encouragement to mutual assistance.. In man, it is the source of most of *his pleasures* ; and without which his reason would be of little benefit.

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* Every one in his childhood has repeatedly bit a part of the glass or earthen vessel, in which his food has been given him, and has thence had a very disagreeable sensation in the teeth, which sensation was designed by Nature to prevent us from exerting them on objects harder than themselves. The jarring sound produced between the cup and the teeth is always attendant on this disagreeable sensation : and ever after, when such a sound is accidentally produced by the conflict of two hard bodies, we feel by association of ideas, the concomitant disagreeable sensation in our teeth. Others have, in their infancy, frequently held the corner of a silk handkerchief in their mouth, whilst their companions in play have plucked it from them, and have given another disagreeable sensation to their teeth, which has afterwards recurred on running the finger along those materials.

A consent of parts may also exist, where the nerves cannot be traced as connected together.

SECTION XL.

OF THE TOUCH.

The peculiar organ of this sense is *the skin*, which covers the whole body, it being needful that the surface should be provided with this sense, that nothing might come into contact with any part of our body, without being perceived.

If we consider the skin only, and reflect how accurately the mind distinguishes each particular portion, which is pressed by the several parts of any object, how surprising must it appear, that the nerves we find assigned to the skin, can supply such numbers of separate fibres, as are necessary for distinguishing in this manner the action upon each almost infinite minute part of so very extended a surface!

As one office of the skin is to be an emunctory, by which the redundancies or effete parts of the blood are thrown forth; for this end it is furnished with numerous pores in every part of it. But between these pores arise, from the external surface of the skin, NERVOUS PAPILLÆ, very minute and contiguous to each other, by which the office of touch is performed.

These are defended by *a mucous substance** spread *between* the *external* and *internal skin*, which being every

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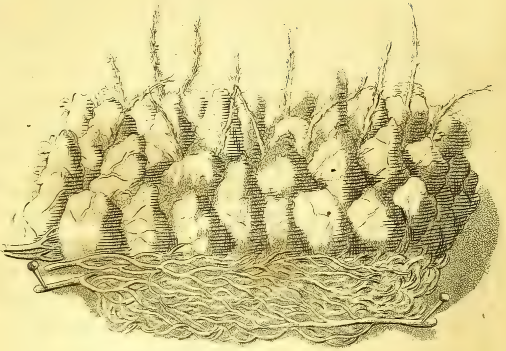
* This gluey matter, soon after birth, grows of a *yellow tinge*, which increases in our riper age. It is *darker*, as the climate is hot, and as we become more exposed to it, and under the line it is of a perfect *black colour*, forming the chief contrast between *black* and *white* men. Dr. Beddoes, in the presence of some pupils who attended his chemical lectures at Oxford, having directed a *black* to immerse his hand in diluted oxygenated marine acid, the hand quickly became milky *white*; but the piebald negro



The Papillæ of the Finger as seen through a Microscope.

Warner del et sculp

London, Pub. by Sherwood, Neely & Jones, 1813

where pierced through by *these papillæ*, receives the name of RETE MUCOSUM.

Besides the pain consequent upon injuries done to the skin, the primary object of sensation in these *papillæ* seems to be *hardness* and *softness:* such bodies as give way to the touch, we call *soft*; others, which resist pressure, so as to cause the skin to yield under them, we call *hard.* And how happily is this sense tempered between the two extremes; being neither too acute nor too obtuse!

By the touch we correct the error of vision. Naturally every object we see appears to be within our reach, for a child, who has yet made but little use of his sense of feeling, would equally grasp at the moon as at objects within his reach. Mr. Cheselden, having couched a boy of thirteen for a cataract, who had hitherto been blind, and having thus at once restored him to sight, has curiously marked the progress of his recovery. He was, at first, couched only in one of his eyes; and when he saw for the first time, he was so far from judging of distances, that he supposed his eyes *touched* every object that he saw, in the same manner as his hands might be said to feel them. It may be for this reason that we often see horses frighted at things, which they have not become acquainted with by means of their nostrils, which serve them in some respects like our hands. The whiskers in animals serve them to measure apertures through which they are to pass.

It has been remarked, that even brutes are intelligent in proportion to the accuracy of their feeling, or as their extremities approach in resemblance to the human hand. The horse and the bull, whose feet are covered with cal-

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resisted any further attempts. On the contrary, a French physician, it is said, by giving a reverend divine silver dissolved in the nitrous acid, converted him wholly into a *black.*—Vide Dr. Beddoes' Works, and La Medicine Eclairée par les Sciences.

lous hoofs, are less intelligent than the dog, and the dog is inferior in acuteness to the ape, who possesses a rude kind of hand.

This sense is the peculiar amusement of infants, and perfects the sense of vision.

SECTION XLI.

OF SMELLING.

The infinitely small particles that are continually detached from the surface of odoriferous bodies, float in the air, which transports them every where, and being drawn into the nostrils by the breath, are applied to the membrane that is distributed in the bony cavity in the inside of the nose.

This membrane is totally covered with infinite ramifications, and convolutions of the *olfactory nerves.*

The great CREATOR, ever attentive to the ease and convenience of his creatures, has furnished the nostrils with a number of *glands*, or small arteries, which secrete a thick mucus, which defends the nerves from the slighter action of the air, or the too powerful stimulus of acrid odours.

Of all the senses, perhaps, there is not one in which man is more inferior to other animals than in that of *smelling*. A dog scents various kinds of game at considerable distances; and, if the fact were not confirmed by daily experience, it could hardly gain credit, that he can trace the odour of his master's foot through all the winding streets of a populous city!

In the selection of food, men are greatly assisted, even in the most luxurious state of society, by the sense of smell. By *smelling* we often reject food as noxious, and will not risk the other test of tasting. Victuals, which have a putrid smell, as equally offensive to our nostrils as hurtful to our constitution, we avoid with abhorrence; but we are allured to eat substances which have a grateful and savoury odour. The more frequent and more acute discernment of brutes in the exercise of this sense is chiefly owing to their freedom, and to their using natural productions alone. But men in society, by the arts of cookery, by the unnatural assemblage of twenty ingredients in one dish, blunt, corrupt, and deceive, both their senses of *smelling* and of *tasting*.

It is not unworthy of remark, that, in all animals, the organs of *seeing*, *smelling*, and *tasting*, are uniformly situated very near each other. Here the intention of NATURE is evident. The vicinity of these three senses form a *triple* guard in the selection of food..

But assistance in the choice of food is not the only advantage that men and other animals derive from the sense of *smelling*. When our senses are not vitiated by unnatural habits, they are not only faithful monitors of danger, but convey to us the most exquisite *pleasures*. The fragrance of a rose, and the perfume of many other flowers, is not only pleasant but gives a refreshing and delightful *stimulus* to the whole system, and may be considered therefore often as a species of wholesome excitement.

SECTION XLII.

OF TASTE.

The smell, as was before observed, has great connexion with the taste. We often are directed by it in judging of our food; and that part of taste which we usually call *flavour*, is a mixed kind of sensation compounded after some manner from both. By the communication between the nose and mouth, the olfactory nerves seem capable of being affected that way; insomuch, that persons who are at the pains to prevent the access of air by the nostrils, swallow nauseous draughts without tasting them.

The gustatory nerves, by which this sensation is received, rise upon the body of the *tongue* in a manner somewhat similar to those in the skin; for PAPILLÆ more visible than those of the skin (otherwise alike) appear in those parts of the tongue that are endued with this sense. *These* are always erected on the application of sapid or stimulating substances. This elevation and extension of the *papillæ*, by bringing larger portions of the nerves into contact with the substances applied to the tongue, give additional strength to the sensation, and enable us to judge with greater accuracy concerning their nature and qualities. The *saliva*, which perpetually moistens the tongue, is a liquor which, though insipid itself, is found in all animals to be a very powerful solvent. Every substance applied to the tongue. is partially dissolved by the saliva before the sensation of taste is excited. And hence when the tongue is rendered dry by disease, or any other cause, the sense of taste is either vitiated or totally destroyed.

The senses of *smell* and *taste* in many other animals greatly excel those of mankind, for in civilized society, as our victuals are generally prepared by others, and are adulterated with salt, spice, oil, and empyreuma, *we do* not hesitate about eating whatever is set before us, and neglect to cultivate these senses: whereas *other animals* try every morsel by the *smell*, before they take it into their mouths, and by the *taste* before they swallow it; and are led each to his proper nourishment by his organs of sense. We may observe that *children*, having abundant excitability, are naturally inclined towards those foods which contain but little stimuli. And, on the contrary, *those* who are *more advanced in life*, and whose excitability is blunted, are fond of the most poignant dishes. Every one must remember how great a pleasure he found in sweets and milk while a *child*. As he *grew older* he insensibly calls to his assistance spices, salts, and aromatics; and delights in those tastes which in childhood he was unable to endure.

SECTION XLIII.

OF IMAGINATION,

An animal may be said to fill up that sphere which he can reach by his senses; and is actually large in proportion to the sphere to which its organs extend. By *sight*, man's enjoyments are diffused into a wide circle;—that of *hearing*, though less widely diffused, nevertheless extends his powers;—the sense of *smelling* is more contracted still;—and the *taste* and *touch* are the most confined of all. Thus man enjoys *very distant objects*, but with *one sense only*; more *nearly* he brings *two senses* at once to bear upon them; his sense of *smelling* assists *the other two*, and at its own distance.

Each sense, however, the more enlarged its sphere, the more capable it is of making *combinations*; and is, consequently, the more *improveable*. Refined imaginations, and men of strong minds, take more pleasure, therefore, in improving the delights of the *distant senses* than in enjoying such as are scarce capable of improvement.

By combining *the objects* of the *extensive senses*, all the arts of poetry, painting, and harmony, have been discovered; but the *closer senses*, if I may so call them, such as smelling, tasting, and touching, are, in some measure, as simple as they are limited, and admit of little variety, *The man* of *imagination* makes a great and an artificial happiness, by the pleasure of *altering* and *combining*; the *sensualist* just stops where he began, and cultivates only those pleasures which he cannot improve. The *sensualist* is contented with those enjoyments that are already made to his hand; but *the man* of *refined pleasure* is best pleased with happiness of his own creating.

SECTION XLIV.

SOCIAL AFFECTION.

This is the mildest and most agreeable of all the mental stimuli. It is this, says Lavater, which has sweetened every bitter of my life; this has alone supported me, when the sorrows of a wounded heart wanted vent.

> Sweet is the breath of morn, her rising sweet,
> With charm of earliest birds; pleasant the sun,
> When first on this delightful land he spreads
> His orient beams, on herb, tree, fruit, and flow'r,
> Glist'ning with dew; fragrant the fertile earth
> After soft show'rs; and sweet the coming on
> Of grateful evening mild: then silent night,
> With this her solemn bird; and this fair moon,
> And these the gems of heav'n, her starry train.
> *But neither breath of morn, when she ascends*
> *With charm of earliest birds: nor herb, fruit, flow'r,*
> *Glist'ning with dew: nor fragrance after show'rs:*
> *Nor grateful ev'ning mild: nor silent night,*
> *With this her solemn bird: nor walk by moon;*
> *Or glitt'ring star-light,* WITHOUT THEE IS SWEET.
>
> MILTON.

SECTION LXV.

OF THE PASSIONS.

The effect of different PASSIONS on the *voluntary* as well as *involuntary organs*, is a subject worthy of scrutiny, and has not been enough attended to by the physiologist.

Anger, *love*, *hope*, *fear*, *joy*, *grief*, are well known to display their signs externally. The character of each man can in general be read in his face. Dissocial passions, being hurtful by prompting violence and mischief, are noted by the most conspicuous external signs, in order to put us upon our guard: thus *anger* and *revenge*, especially when sudden, display themselves on the countenance in the most legible characters. The breathing is quick, with deep inspirations; hence the swelling of the nostrils, and projecting of the under lip; the accumulated nervous electricity now passes the GANGLIONS, which Nature designed as *barriers* in the more tranquil hour, and flies to the heart, which propels with velocity the blood, which being very deeply *oxygenated* in its quick transit through the lungs, aids muscular exertion, inflames the eye, and reddens the countenance. The other internal viscera are also affected, and there is a suffusion of bile.

The patience, firmness, and magnanimity, with which the officers and soldiers of the American army endured the complicated evils of hunger, cold, and nakedness, can only be ascribed to an insensibility of body, produced by an uncommon tone of mind, excited by the love of *liberty* and the *hatred* of the enemy: for the war was carried on by the Americans against a nation, to whom they had long been tied by the numerous obligations of consanguinity, laws, religion, commerce, language, interest, and a mutual sense of national glory; the *resentment* of the Americans rose of course, as is usual in all disputes, in proportion to the number and force of these ancient bonds of affection and union. On this same principle it is, that savages, to satiate their revenge, bear with uncommon patience, and without injury, all the severities of cold and hunger, and have been known to wait even eight or ten months in ambush to destroy an adversary.

LOVE.

Love, the most universal and grateful passion of human nature, which, in general, neither assumes the violence of *anger*, nor sinks into the depression of *grief*, may be considered as a *temperate stimulus*; but in its vicissitudes and extremes, it may acquire the impetuosity of the *first*, or the despondency of the *latter*.

FEAR.

In *fear* there is a deep inspiration, and it is long before the air vitiated in the lungs is returned, the mouth is wide gaping, the nostrils closed, and the heart receiving *unoxygenated* blood palpitates, the countenance is livid, the hands pale, and swooning often ensues. The serpents in Africa, according to Vaillant, fix their eyes on a bird, and curling themselves up, so terrify these little creatures, that they are incapable of flight, and fall down from the bush or tree dead. *Sorrow* produces nearly the same inattention to respiration; hence the nostrils are drawn downwards, the mouth is half open for languid respiration, sighs are frequent, the face is of a lead colour, and the lips are pale. We shall not enter *now* more deeply into the question, but conclude by observing, that the *external signs* of passion are a strong indication that man, by his very constitution, is framed to be open and sincere. A child, in all things obedient to the impulses of Nature, hides none of its emotions; the savage and clown, who have no guide but pure Nature, expose their hearts to view, by giving way to all the natural signs. And even when men learn to dissemble their sentiments, and when behaviour degenerates into art, there still remains checks, that keep dissimulation within bounds, and prevent a great part of its mischievous effects. The total suppression of the voluntary signs during any vivid passion, begets the utmost uneasiness, which cannot be endured, but by the most practised villains. We may pronounce, therefore, that *Nature*, herself sincere and candid, intends that mankind should preserve the same character, by cultivating simplicity and truth, and banishing every sort of dissimulation.

ANGER.

Anger, in its operation on the animal œconomy, is one of the strongest of the *mental stimuli*. It rouses the heart and arteries into greater action, produces an ardent glow over the whole body, but more especially in the face; the eyes look red, the voice is loud, and the muscular powers are increased: hence gout, palsy, &c. have been all removed by violent paroxysms of rage.

But this stimulus is usually too active in its operation to be friendly to health.

The Philadelphia militia who joined the remains of General Washington's army, in December 1776, and shared with them a few days afterwards, in the capture of a large body of Hessians at Trenton, consisted of 1500 men, most of whom had been accustomed to the habits of a city life. These men slept in tents and barns, and sometimes in the open air, during the usual colds of December and January; and yet there were only two instances of sickness, and only one of death, in that body of men in the course of near six weeks, in those winter months. This *extraordinary healthiness* of so great a number of men, under such trying circumstances, says Dr. Rush, can only be ascribed to the vigour infused into the body from the strong passions of the mind rendering the body insensible to the ordinary causes of disease.

ENTHUSIASM.

It is well known that persons under strong prepossessions of mind, have exposed themselves * to extreme bodily tortures without expression of pain, and have also endured long fastings, the extremities of heat and cold, the infection of contagious distempers, and other hazardous things without feeling the consequences that would most probably have taken place, had not the nervous feelings been more forcibly pre-occupied.

HOPE.

Soft smiling HOPE, thou anchor of the mind,
The only comforter the wretched find;
All fly to thee when anguish wrings the heart,
To soothe, by future prospects, present smart.

Faith is more than medicine, is often said; and this can only arise from the exhilirant stimulus of Hope.

CURIOUS FACT.

"The city of Breda, in the year 1625, from a long siege, suffered all the miseries that fatigue, bad provisions, and distress of mind could bring on its inhabitants. Among other misfortunes, the *scurvy* made its appearance, and carried off great numbers. This, added to the other calamities, induced the garrison to incline towards a surrender of the place, when the Prince of Orange, anxious to prevent its loss, and unable to relieve the garrison, contrived, however, to introduce letters addressed to the men, promising them the most speedy assistance. *These were accompanied with medicines against the scurvy, said to be of great price, but of still greater efficacy*; *many more were to be sent there. Three small vials of medicine were given to each physician. It was publicly given out, that three or four drops were sufficient to impart a healing virtue to a gallon of water.* We now displayed our wonder-working balsams. Nor even were the commanders let into the secret of the cheat upon the soldiers. They flocked in crowds about us, every one who had the scurvy soliciting that some part might be reserved for his use. Cheerfulness again appears in every countenance, and an *universal Faith* prevails in the sovereign virtues of the remedies. The effect of this delusion was truly astonishing, *for many were quickly and perfectly recovered. Such as had not moved their limbs for a month before, were seen walking the streets with their limbs sound, straight, and whole.* They boasted of their cure by the Prince's remedy, the motion of their joints being restored by simple friction with oil, and the belly now of itself performed its office, or at least with a small assistance from medicine. Many, who had declared that they had been rendered worse by all former remedies, recovered *in a few days* to their inexpressible joy, and the no less general surprise, by their taking what we affirmed to be their gracious *Prince's cure. This curious relation*," adds Dr. Lind*, "*would hardly perhaps gain credit, were it not in every respect consonant to the most accurate observations, and best attested descriptions of that disease. It is given us by an eye-wit-*

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* Tolerantia inediæ atque algoris mirabilis. Boerhaav. Aphorism. 1120.

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* Lind on the Scurvy, p. 349.

ness, an author of great candour and veracity, who, as he informs us, wrote down every day the state of his patients, and seems more to be surprised with their unexpected recovery than he probably would have been, had he been better acquainted with the nature of this surprising malady. An important lesson in physic," adds this excellent writer, "*is hence to be learned, the wonderful and powerful influence of the passions of the mind on the state and disorders of the body. This is too often overlooked in the cure of disorders, many of which are sometimes attempted by the sole mechanical operation of drugs, without calling in to our assistance the strong powers of the imagination, or the concurring influences of the soul. Hence it is, that the same remedy will not always produce the same effect, even in the same person, and that common remedies often prove wonderfully successful in the hands of men not of the faculty, which do not answer the purpose in a timorous and distrustful patient.*"

SECTION XLVI.

ON CHEERFULNESS.

What blessings THY free bounty gives
  Let me not cast away;
For GOD is paid when man receives,
  T' *enjoy* is to *obey*.

As I was betwixt sleeping and waking, methought on a sudden I perceived one of the most shocking figures imagination can frame advancing towards me. She was drest in black, her skin was contracted into a thousand wrinkles, her eyes deep sunk in her head, and her complexion pale and livid as the countenance of death. Her looks were filled with terror and unrelenting severity, and her hands armed with whips and scorpions. As soon as she came near, with a horrid frown, and a voice that chilled my very blood, she bid me follow her. I obeyed, and she led me through rugged paths, beset with briars and thorns, into a deep solitary valley. Wherever she passed the fading verdure withered beneath her steps; her pestilential breath infected the air with malignant vapours, obscured the lustre of the sun, and involved the fair face of heaven in universal gloom. Dismal howlings resounded through the forest, from every baleful tree the night-raven croaked his dreadful note, and the prospect was filled with desolation and horror. In the midst of this tremendous scene she addressed me in the following manner:

" Retire with me, O rash unthinking mortal, from the " vain allurements of a deceitful world, and learn that " *pleasure* was not designed the portion of human life. " Man was born to *mourn* and to be *wretched*; this is the " condition of all below the stars, and whoever endeavours " to oppose it, acts in contradiction to the will of heaven. " Fly then from the fatal enchantments of youth and " social delight, and here consecrate the solitary hours " to lamentation and woe. *Misery* is the duty of all sublunary beings, and every *enjoyment* is an *offence* to the " DEITY, who is to be worshipped only by the mortification of every sense of pleasure, and the everlasting exercise of sighs and tears."

This melancholy picture of life quite sunk my spirits, and seemed to annihilate every principle of happiness within me. I threw myself beneath a blasted yew, where the winds blew cold and dismal round my head, and dreadful apprehensions chilled my heart. Here I resolved to lie till the hand of death, which I impatiently invoked, should put an end to the miseries of a life so deplorably wretched. In this sad situation I spied on one hand of me a deep muddy river, whose heavy waves rolled on in slow and sullen murmurs, when I found myself suddenly surprised by the sight of the loveliest object I ever beheld. The most engaging charms of youth and beauty appeared in all her form; effulgent glories sparkled in her eyes, and their awful splendours were softened by the gentlest looks of compassion and peace. At her approach, the frightful spectre, who had before tormented me, vanished away, and with her all the horrors she had caused. The gloomy clouds brightened into cheerful sun-shine, the groves recovered their verdure, and the whole region looked gay and blooming as the garden of Eden. I was quite transported at this unexpected change, and reviving hope began to glad my thoughts, when, with inexpressible sweetness, my beauteous deliverer thus uttered her divine instructions:

"My name is RELIGION. I am the offspring of "TRUTH and LOVE, and the parent of BENEVOLENCE, "HOPE, and JOY. That monster, from whose power I have "freed you, is called SUPERSTITION; she is the child "of DISCONTENT, and her followers are FEAR and SOR-"ROW. Thus, different as we are, she has often the inso-"lence to assume *my name* and *character*, and seduces "unhappy mortals to think us the *same*, till she at length "drives them to the borders of despair, that dreadful abyss "into which you were just going to sink.

"Look around and survey the various beauties of the "globe, which heaven has destined for the seat of the "human race, and consider whether a world thus exqui-"sitely framed could be meant for the abode of misery "and pain. For what end has the lavish hand of PRO-"VIDENCE diffused such innumerable objects of delight,

" but that all might *rejoice* in the privilege of existence, " and be filled with gratitude to the beneficent Author of " it? Thus to enjoy the blessings he has sent, is virtue " and obedience; and to reject them merely as means of " pleasure, is pitiable ignorance, or absurd perverseness. " Infinite goodness is the source of created existence; the " proper tendency of every rational being, from the highest order of raptured seraphs, to the meanest rank of " men, is to rise incessantly from lower degrees of happiness to higher. They have each faculties assigned " them for various orders of delights."

" What," cried I, " is this the language of RELIGION? " Does she lead her votaries through flowery paths, and bid " them pass an unlaborious life?" " The *true enjoyments* " of a reasonable being," answered she mildly, " do not " consist in *unbounded indulgence* or *luxurious ease*, in the " *tumult* of *passions*, the *langour* of *indulgence*, or the " *flutter* of *light amusements*. Those are often raised " into the *greatest transports* of *joy* who are subject to the " *greatest depressions* of *melancholy*: on the contrary, " CHEERFULNESS, though it does not give the mind such " an exquisite gladness, prevents us from falling into any " depths of sorrow. MIRTH is like a flash of lightning, " that breaks through a gloom of clouds, and glitters for " a moment; CHEERFULNESS keeps up a kind of day-light " in the mind, and fills it with a steady and perpetual " serenity."

If we consider cheerfulness in three lights,

1. *With regard to ourselves*,
2. *To those we converse with*, and
3. *To the great Author of our being*,

it will not a little recommend itself on each of these accounts.

1st. The man who is possessed of *this excellent frame of mind* is not only easy in his thoughts, but a perfect master of all the powers and faculties of the soul: his imagination is always clear, and his judgment undisturbed: his temper is even and unruffled, whether in action or solitude. He comes with a relish to all those goods which Nature has provided for him, tastes all the pleasures of the creation which are poured about him, and does not feel the full weight of those accidental evils which may befal him.

2dly. If we consider him *in relation to the persons whom he converses with,* it naturally produces love and good-will towards him. A CHEERFUL MIND is not only disposed to be affable and obliging, but raises the same good humour in those who come within its influence. A man finds himself pleased, he does not know why, with the cheerfulness of his companion: it is like a sudden sun-shine, that awakens a secret delight in the mind, without her attending to it. The heart rejoices of its own accord, and naturally flows out into friendship and benevolence towards the person who has so kindly an effect upon it.

3dly. When I consider this CHEERFUL STATE OF MIND in its third relation, I cannot but look upon it as a *constant habitual gratitude* to the great AUTHOR of NATURE. An *inward cheerfulness* is an implicit praise and thanksgiving to PROVIDENCE under all its dispensations. It is a kind of acquiescence in the state wherein we are placed, and a secret approbation of the *Divine Will* in his conduct towards man.

Such considerations as these we should perpetually cherish in our thoughts; they will banish from us all that secret heaviness of heart which unthinking men are subject to when they lie under no real affliction, all that anguish which we may feel from any evil that actually oppresses us, to which I may likewise add those little cracklings of mirth and folly, that are apter to betray virtue than support it; and establish in such an EVEN and CHEERFUL TEMPER, as makes us pleasing—to *ourselves*—to *those* with whom we converse, and—to *him* whom we are made to please.

CHEERFULNESS is, in the next place, the best promoter of *health.* Repinings and secret murmurs of heart give imperceptible strokes to those delicate fibres of which we are composed, and wear out the machine insensibly; not to mention the injury they do the blood, and those irregular disturbed motions which they raise in the vital functions. I scarce remember, in my own observation, to have met with many old men, or with such, who (to use our English phrase) wear well, that had not at least a certain calmness in their humour, if not a more than ordinary gaiety and cheerfulness of heart.

Cheerfulness bears the same friendly regard to *mind* as to the *body*; it banishes all anxious care and discontent, soothes and composes the passions, and keeps the soul in a perpetual calm.

There are writers of great distinction who have made it an argument for PROVIDENCE, that the whole earth is covered with *green* rather than with any other colour, as being such a right mixture of light and shade, that it comforts and strengthens the eye instead of weaking or grieving it. For this reason several painters have a green cloth hanging near them to ease the eye upon, after too great an application to their colouring. A famous modern philosopher accounts for it in the following manner:—" *All* " *colours that are more luminous, overpower and dissipate*

“ *the animal spirits which are employed in sight:—on* “ *the contrary, those that are more obscure do not give* “ *the animal spirits a sufficient exercise; whereas the rays* “ *that produce in us the idea of green, fall upon the eye* “ *in such a due proportion, that they give the animal spirits* “ *their proper play, and, by keeping up the struggle in a* “ *just balance, excite a very pleasing and agreeable sen-* “ *sation.*” Let the cause be what it will, the effect is certain; for which reason the poets ascribe to this particular colour the epithet of *cheerful.*

To consider further this double end in the works of Nature, and how they are, at the same time, both useful and entertaining, we find that the most *important* parts in the vegetable world are those which are the most *beautiful.* These are the seeds by which the several races of plants are propagated and continued, and which are always lodged in flowers or blossoms. Nature seems to hide her principal design, and to be industrious in making the earth gay and delightful, while she is carrying on her great work, and intent upon her own preservation. The husbandman, after the same manner, is employed in laying out the whole country into a kind of garden or landscape, and making every thing smile about him, whilst in reality he thinks of nothing but of the harvest, and increase of fortune which is to arise from it.

We may further observe how PROVIDENCE has taken care to keep up this *cheerfulness* in the mind of man, by having formed it after such a manner as to make it capable of conceiving delight from several objects which seem to have very little use in them, as from the wildness of rocks and deserts, and the like grotesque parts of Nature. In short, the whole universe is a kind of theatre filled with objects that either raise in us pleasure, amusement, or admiration.

The reader's own thoughts will suggest to him the vicissitude of day and night, the change of seasons, with all that variety of scenes which diversify the face of Nature, and fill the mind with a perpetual succession of beautiful and pleasing images. I shall omit to mention the several entertainments of *art*, with the pleasures of *friendship*, *books*, *conversation*, and other *accidental diversions* of life, because I would only take notice of such incitements to a *cheerful temper*, as offer themselves to persons of *all ranks* and *conditions*, and which may *sufficiently shew us*, that PROVIDENCE did not design *this world* should be filled with *murmurs* and *repinings*, and that the heart of man should be involved in perpetual *gloom* and *melancholy*.

LAWS OF THE NERVOUS SYSTEM.

SECTION XLVII.

LAW I.

A DUE EXCITEMENT OF THE NERVES IS NECESSARY FOR THE MAINTENANCE OF VIGOUR OF BOTH BODY AND MIND.

As the health of the several organs of the body consists in a due adaption of the appropriate stimuli, so the nerves of the animal œconomy require also to possess vigour and a just proportion of mental stimulus.

Let us now consider the nature of man in his most savage or wild state. His Majesty George I. was out a hunting with his attendants in the forest of Hertswold, in the electorate of Hanover, when PETER, the wild boy, as he was afterwards called, was found in the hollow of an oak, and appeared to have subsisted upon leaves, berries, and the bark of trees, for a considerable time. He was about 12 or 13 years of age. In the following year he was brought over to England. Upon the approach of bad weather he always appeared sullen, and uneasy. At particular seasons of the year he shewed a strong propensity to steal into the woods, and would eagerly feed upon raw cabbage, leaves, acorns, berries, and devour the young bark of trees, which evidently proved, that he had subsisted in that manner for a considerable time before he was first taken. Hence some have supposed he was really an idiot, although he had by no means the countenance of one; and Lord Monboddo assures us, that he knew an officer, a man of very good sense, who was quartered where Peter lived for some months, and saw him almost every day, and who affirmed that he was no idiot, but shewed marks of common understanding, which was all that could be expected from one in his state. By order of the Queen he was put under the care of Dr. Arbuthnot, with proper masters to attend him. But notwithstanding there seemed to be no natural defect in his organs of speech, after all the pains that had been taken with him, he could never be brought to say more than *Peter* and *King George*, and proved incapable of receiving instruction. Peter could therefore never be more than tamed, so weakened were the powers of his understanding for want of its proper and early culture.

SECTION. XLVIII.

ON THE PLEASURES OF THE POOR MAN.

——————— Turn we to survey
Where rougher climes a nobler race display,
Where the bleak *Swiss* their stormy mansions tread,
And force a churlish soil for scanty bread.

No product here the barren hills afford,
But man and steel, the soldier and his sword.
No vernal blooms their torpid rocks array,
But winter lingering chills the lap of May;
No zephyr fondly sues the mountain's breast,
But meteors glare, and stormy glooms invest.

Yet still, e'en here, CONTENT can spread a charm,
Redress the clime, and all its rage disarm.—
Cheerful at morn, he wakes from short repose,
Breathes the keen air, and carols as he goes:
With patient angle trolls the finny deep,
Or drives his vent'rous plough-share to the steep;
Or seeks the den where snow-tracks mark the way,
And drags the struggling savage into day.
At night returning, every labour sped,
He sets him down the monarch of a shed;
Smiles by his cheerful fire, and round surveys
His children's looks, that brighten at the blaze;
While his lov'd partner, boastful of her hoard,
Displays her cleanly platter on the board:
And haply too some pilgrim, thither led,
With many a tale repays the nightly bed.

SECTION XLIX.

ON THE PLEASURES OF A CULTIVATED MIND.

Such are the charms to barren states assign'd.
Their *wants* but *few*, their *wishes all confin'd*.
Yet let them only share the praises due;
If *few* their *wants*, their *pleasures* are but *few*:
For *every want* that *stimulates* the breast
Becomes a *source* of *pleasure* when redrest.
Whence from such lands each pleasing science flies,
That first *excites desire, and* then *supplies;*
Unknown to them, when sensual pleasures cloy,
To fill the languid pause with finer joy;
Unknown those powers that raise the soul to flame,
Catch every nerve and vibrate through the frame,

Their level life is but a mould'ring fire,
Unquench'd by want, unfann'd by strong desire;
Unfit for raptures; or, if raptures cheer
On some high festival of once a year,
In wild excess the vulgar breast takes fire,
Till, buried in debauch, the bliss expire.

There is not, says Dr. John Brown, *a finer stimulus*, than the pleasurable feeling proceeding from a happy train or flow of thinking; hence the delight that arises from a flight of *wit*, or from a pleasant vein of *humour*; hence all the fine feelings of the *belles lettres*; hence in youth, the *enthusiasm*, so natural to the human feelings, to out-strip all others in every mental excellency. The arts, the sciences, every department of human knowledge, are all the effects of that intellectual propensity. How happy would it be for mankind were this noble stimulus duly cherished! What benefits, which society is deprived of, would accrue from a proper cultivation of it! What must have been the delight of Pythagoras, when he found out the forty-seventh proposition! He jumped about in an ecstasy, crying out Ευρηκα; and was so much more substantial than his other few brother discoverers, as to possess the means of offering a sacrifice of an hundred fat bullocks to the gods! How delightful must the feelings of Milton have been, in whose works every page is an effort of the most beautiful, and of the most sublime conceptions of human genius!

What were the lively sensations of Pope, Cowley, and Darwin, whose sportive imaginations called at will myriads of beautiful scenes! How delightful the emotions of those orators, whose eloquence hath saved their respective countries; of those preachers, who have rooted out the malignant passions, and implanted in their room the most perfect philanthropy; and lastly, of physicians, from whose philosophy a NEW MEDICINE hath arisen with healing on her wings.

SECTION L.

Law II.

A TOO GREAT EXCITEMENT OF THE MIND ENFEEBLES THE POWERS OF THE UNDERSTANDING AND WEAKENS THE BODY.

Of Exhaustion.

The state of *exhaustion* in the nerves as in the irritable fibre, may be either,

1. *Temporary*, or,
2. *Irreparable.*

In the state of *temporary exhaustion*, the mind is tired, and, like the body, recovers its due tone only by rest:—but in the state of *permanent exhaustion*, this recovery is irreparable.

SECTION LI.

OF TEMPORARY EXHAUSTION.

> Just as the morning steals upon the night,
> Melting the darkness, so their rising senses
> Begin to chace away the fumes that mantle
> Their clearer reason. Their understanding
> Begins to swell, and the approaching tide
> Will *shortly* fill the reasonable shore
> That now lies foul and muddy.
>
> Shakspeare.

To shew the diminution of *sensibility* from increased action, if one hand be put into very warm water, and then immersed with the other into subtepid water, to the former this water will appear extremely cold, while to the other hand it will impart an agreeable warmth. For the same reason we feel a chilliness on coming into an atmosphere of a temperate warmth, after having been for some time in a very close apartment. Hence we are unable clearly to distinguish objects, immediately after we have seen a bright flash of lightning pervade the gloom of night. Thus Milton, in describing the light and glory which flows from the divine presence and the majesty of God, says,

> *Dark* with *excessive light* thy skirts appear.

Here is an idea not only practical in an high degree, but strictly and philosophically just. *Extreme light*, by overcoming the organs of sight, obliterate all objects, so as in its effects exactly to resemble darkness. Thus, after having looked at the setting sun for a short time, if we turn our eyes to a less splendid part of the heaven, a dark spot will be perceived exactly resembling the shape of that bright luminary.

That these phænomena depend upon the *exhaustion* of *sensibility*, may be proved also by looking stedfastly on a area of scarlet silk of about an inch diameter spread on white paper, the scarlet colour will gradually become fainter, until it entirely vanishes, if the eye be kept uniformly upon it. Or if you look at a surface of light blue, and then place upon it a smaller surface painted of the ultramarine blue, the appearance of the light blue will be nearly obliterated. It is on this account that painters put in their first shades darker than a bye-stander ignorant of this law would imagine right, and produce the greatest effect by the contrast of shades.

That violent exertions of the mind fatigue the frame as much, if not more, than bodily labour, every day furnishes abundant proof.

During the late war with America, when it was proposed to continue on hostilities, Lord Chatham, at the close of a very long and animating speech, said——My lords you cannot conquer America. No man thinks more highly of my country than I do. I love and honour the English troops. I know their virtues and their valour. I know they can achieve any thing, except impossibilities. As to the conquest of America, I repeat, my lords, it is impossible. You may swell every expence and every effort still more extravagantly; pile and accumulate every mercenary assistance you can beg or borrow; traffic and barter with every little pitiful German prince that sells his subjects to the shambles of a foreign power: your efforts are for ever vain and impotent; doubly so from this mercenary aid on which you rely: for it irritates to an incurable resentment the minds of your enemies. To overrun them with the mercenary sons of rapine and plunder, devoting them and their possessions to the rapacity of hireling cruelty! If I were an American as I am an Englishman, while a foreign troop was landed in my country, I would never lay down my arms: NEVER—NEVER—NEVER.

Your army is infected with the contagion of these illiberal allies: the spirit of plunder and of rapine is gone forth among them. I know it, I am informed from the most experienced officers that our discipline is deeply wounded. Whilst this is notoriously *our* sinking situation, AMERICA grows and flourishes: whilst *our* strength is lowered, *their's* rises and improves.

But, my lords, in addition to these disgraces and mischiefs of our army, the ministers have dared to authorize and associate to our arms the tomahawk and scalping knife of the savage! have called into civilized alliance the wild and inhuman savage of the wood! have delegated to the merciless Indian the defence of disputed rights, and to wage the horrors of his barbarous war against even brethren!

My lords, this enormity cries aloud for redress, and unless thoroughly done away, it will be a stain on the national character; it is a violation of the constitution; I believe it is against the law.

It is not amongst the least of our national misfortunes, that our army is infected with the mercenary spirit of robbery and rapine, for, familiarized to the horrid scenes of cruelty, it can no longer boast of the noble and generous principles which dignify a soldier, no longer sympathize with "*the dignity of the royal banner*," nor feel "*the pride, pomp, circumstance of glorious war*," *that make ambition virtue.*—What makes ambition *virtue?*—A sense of *honour:*—but is a sense of *honour* consistent with a spirit of plunder, and the practice of murder! Can it flow from mercenary motives? Or can it prompt to cruel deeds?

My lords, the time demands the language of truth: we must not now lay the flattering unction of servile compliment or blind adulation. In a just or necessary war, to maintain the rights or the honour of my country, I would strip the shirt from my back to support it: but in such a war as *this*, unjust in all its principles, impracticable in its means, and ruinous in its consequences, I would not contribute a single effort, or a single shilling. In this complicated crisis of danger, weakness at home, and calamity abroad, terrified and insulted by the neighbouring powers; unable to act in America, or acting only to be destroyed, where is the man with the forehead to say our affairs are in a hopeful situation! who has the forehead to promise or to hope success from such a situation, or from perseverance in those measures that have driven us to it?

But if in an obstinate and infatuated perseverance in folly we meanly echo back the words this day offered to us, we shall madly rush into multiplied miseries, and confusion worse confounded. Is it possible? Can it be believed, that ministers are yet blind to their impending destruction? I did hope that instead of this false and empty vanity; this overweaning pride engendering high conceits, and "presumptuous imaginations," that ministers would have humbled themselves in their errors; would have confessed and retracted them; and by an active though late repentance have endeavoured to redeem them.

But, my lords, since they had neither sagacity to foresee, nor justice nor humanity to shun, these oppressive calamities: since not even severe experience can make them feel, nor the imminent ruin of their country awaken them from their stupefaction; the guardian care of parliament *must* interpose.

The Americans contending for their rights against our arbitrary exactions I love and admire. It is the struggle of free and virtuous patriots. But contending for a *total disconnection* from England, as an Englishman I cannot wish them success, for on this connection depends the mutual happiness and prosperity of both England and America. They derived encouragement, assistance, and protection from us, and we reaped from her the most important advantages. She was indeed the foundation of our wealth, the nerve of our strength, the nursery and basis of our naval power. It is our duty, my lords, most anxiously to endeavour the recovery of these inestimable, these most beneficial advantages: and in this perilous crisis, perhaps the present moment may be the only one in which we can hope for success. For the natural disposition of America as yet leans towards England, towards the old habit of connection and mutual interest that united both countries. This was the established sentiment of all the continent: and still, my lords, in the great and principal part, the sound part of America, the middle and southern colonies, this wise and affectionate disposition prevails: and there is a very important and considerable part of America yet sound. Some parts may be blind to their true interests; but if we express a just, a wise, and a benevolent disposition to participate with them those immutable rights of nature and constitutional liberties, to which they are equally entitled with ourselves: by a conduct so just and humane, we shall confirm the most favourable, and conciliate the most adverse. I say, my lords, the rights and liberties to which they are equally entitled with ourselves; but *no more.* I would participate to them every enjoyment and every freedom which the colonizing subjects of a free state can possess, or wish to possess: and I do not see why they should not enjoy every fundamental right in their property, and every original substantial liberty that Devonshire or Surry, or the county I live in, or any county in England can claim. I shall, therefore, my lords, propose to you an amendment to the address to his Majesty; "*to recommend* (instead of prosecuting "further this calamitous war) *an immediate cessation of* "*hostilities; and the commencement of a treaty to restore* "*peace and liberty to America, strength and happiness to Eng*"*land; security and permanent prosperity to both countries.*"

This, my lords, is yet in our power, and let not the wisdom and justice of your lordships neglect the happy and perhaps the only opportunity. By the establishment of irrevocable laws, founded on mutual rights, and ascertained by a treaty, these glorious enjoyments may be firmly perpetuated. The sound parts of America, of which I have spoken, must be sensible of these great truths, and of their real interests. America is not in that state of desperate and contemptible rebellion which this country has been deluded to believe. It is not a wild and lawless banditti, who having nothing to lose might hope to snatch something from public convulsions; many of their leaders and principal men have a great stake in this contest; and let me again repeat to your lordships, that the strong bias of America, at least of the wiser and sounder part of it, naturally inclines to this happy and constitutional re-connection with YOU.

Lord Chatham was supported in his proposed amendment by Lord Abingdon, Lord Shelburne, the Duke of Grafton, Lord Camden, the Duke of Richmond, Lord Effingham, and the Bishop of Peterborough.

Lord Abingdon was short and spirited. Lord Shelburne, as usual, discussed the subject in a very ample and comprehensive manner. The Duke of Grafton spoke long, and with much earnestness, preserving at the same time, what generally characterizes this nobleman's speaking, a decent and chastised stile of dignity. Lord Camden was augmentative, fluent, sincere, and animated. The Duke of Richmond was a powerful assistant to the noble mover of the amendment. And the Bishop of Peterborough pronounced a short and pithy opinion on the question; clothed in language uniting qualities rarely found together, being both nervous and elegant.

On the other side there were many able speakers, who supported the continuance and principle of the war. With respect to the employment of Indians, Lord Suffolk said, it was a measure necessary in fact, and allowable in principle: for it was perfectly justifiable to use every means against our enemies, that GOD and NATURE had put into our hands.

Lord Chatham rose.—I am astonished—shocked—to hear such principles confessed :—to hear them avowed in this house, or in this country :—principles equally unconstitutional, inhuman, and unchristian.—My lords, I did not intend to have encroached again on your attention :—but I cannot repress my indignation :—I feel myself impelled by every duty.—My lords, we are called upon as members of this house, as Christian men, to protest against such notions standing near the throne, polluting the ear of majesty.—That GOD and NATURE put into our hands ! !—I know not what ideas that lord may entertain of GOD and NATURE: but I know that such abominable principles are equally abhorrent to RELIGION and HUMANITY.—What—to attribute the sacred sanction of GOD and NATURE to the massacres of the Indian scalping knife !—to the cannibal savage torturing, murdering, roasting, and eating,—literally, my lords, eating the mangled victims of his barbarous battles !—Such horrible notions shock every precept of religion, divine or natural, and every generous feeling of humanity : and, my lords, they shock every sentiment of honour :—they shock me, as a lover of honourable war, and a detester of murderous barbarity.—These abominable principles, and this more abominable and shameful avowal of them, demand the most decisive indignation.—I call upon that right reverend bench, those holy ministers of the gospel and pious pastors of our church :—I conjure them to join in the holy work, and vindicate the religion of their God !—I appeal to the wisdom of this learned bench to defend and support the justice of their country :—I call upon the bishops to interpose the unsullied sanctity of their lawn :—upon the reverend judges to interpose the purity of their ermine, to save us from this pollution.—I call upon the honour of your lordships to reverence the dignity of your ancestors, and to maintain your own :—I call upon the spirit and humanity of my country to vindicate the national character:—I invoke the genius of the constitution, from the tapestry that adorns these walls, the immortal ancestor* of this noble lord, who frowns with indignation at the disgraces of his country.—In vain he led your victorious fleets against the boasted Armadas of Spain; in vain he defended and established the honour, the liberties, the religion, the Protestant religion of this country against the arbitrary cruelties of Popery and the Inquisition; if these more than Popish cruelties and inquisitorial practices are let loose among us.—To turn forth into our settlements, among our ancient connections, friends, and relations, the merciless cannibal thirsting for the blood of man, woman, and child!—To send forth the infidel savage—against whom?—Against your protestant brethren!—To lay waste their country; to desolate their dwellings, and extirpate their race and name, with their hell-hounds of savage war!—Hell-hounds I say of savage war. Spain armed herself with blood-hounds to extirpate the wretched nations of America:—and we improve on the inhuman example even of Spanish cruelty. We turn loose these savage hell-hounds against our brethren and countrymen in America, of the same language, laws, liberties, and religion:—endeared to us by every tie that should sanctify humanity.

My lords, this awful subject, so important to our honour, our constitution, and religion, demands the most solemn and effectual enquiry: and I again call upon your lordships, and the united powers of the state, to examine it thoroughly and decisively, and to stamp upon it an indelible stigma of public abhorrence: and I again implore those holy prelates of our religion to do away these iniquities from among us. Let them purify this house, and this country, from so great a sin.

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* Lord Effingham Howard, Queen Elizabeth's Lord High Admiral.

My lords, I am old, and weak; and *at present* UNABLE *to say more:*——but my feelings and my indignation were too strong to have said less. I could not have slept this night in my bed, nor reposed my head upon my pillow, without giving this vent to my eternal abhorrence of such preposterous and enormous principles.*

SECTION LII.

OF PERMANENT EXHAUSTION.

Curæ leves loquunter, ingentes *stupent.*

TAC.

Notwithstanding a negative had been put upon every proposition and motion made by Lord CHATHAM concerning *America*, yet he resolved to persevere in the same line of conduct. To his zeal in this cause he sacrificed his life. He had not strength of frame sufficient to bear the exertions he made. He was now advanced in the seventieth year of his age, and suffered the severest attacks of gout; but although debilitated by infirmity, and enervated by anguish of body and mind, still he refuses to yield to the calls of his disorder, or to mitigate his pains by the indulgence of a bed—while his country was bleeding, he felt for *her* and not for *himself. Her* honour and splendour had been his glory and his pride—*her* debasement and adversity were now the only subjects of his concern and anxiety.

On the 7th day of April, 1778, the Duke of RICHMOND having moved to present an address to the king on the subject of the state of the nation, in which the necessity of admitting the *full* INDEPENDENCE of *America* was hinted, Lord Chatham, for the last time, rose to speak in the House of Lords.

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* This famous speech was obtained from a MS. in the possession of his celebrated son, William Pitt.

My lords, he said, I rejoice that the grave has not closed upon me; that I am still alive to lift up my voice against the dismemberment of this ancient and most noble monarchy! Pressed down as I am by the hand of infirmity, I am little able to assist my country in this most perilous conjuncture; but, my lords, while I have sense and memory, I will never consent to deprive the royal offspring of the house of BRUNSWICK of their fairest inheritance. Where is the man that will dare to advise such a measure? My lords, his Majesty succeeded to an empire as great in extent as its reputation was unsullied. Shall we tarnish the lustre of this nation by an ignominious surrender of its *rights* and *fairest possessions?* Shall this great kingdom truckle to the house of BOURBON? Shall a people, that seventeen years ago was the terror of the world, now stoop so low as to tell its ancient inverate enemy, "Take all we have, only allow us peace?" Is it possible!—I wage war with no man, or set of men.—I wish for none of their employments;—nor would I co-operate with men (alluding to the Duke of Richmond) who instead of acting on a firm decisive line of conduct, halt between two opinions, where there is no middle path. In GOD's name, if it is absolutely necessary to declare either peace or war, and the former cannot be preserved with honour, why is not the latter adopted without hesitation? I am not, I confess, well informed of the resources of this kingdom; but, my lords, any state is better than despair, and I trust it has still sufficient to maintain its *just rights*. Let us at least make another effort; and if we must fall, let us fall like men.

The Duke of Richmond having spoken rather harshly to some parts of Lord Chatham's speech, his lordship, *greatly moved*, attempted to rise in reply; but after two or three efforts to stand, he fainted and fell down on his seat. The Duke of Cumberland, Lord Temple, Lord Stamford and other lords, caught him in their arms. The house was immediately cleared, and the windows thrown open. This venerable patriot was carried to an adjoining room, and the house immediately adjourned.—This unhappy event proved the melancholy prelude to his death. He languished at Hayes until the 11th of May, 1778, when he died; to the sincere regret of every person who has a just sense of human dignity and virtue.

Livy has handed down to us the story of King Attalus, who, as he was advising the Bæotians to make an alliance with Rome, died in the midst of his discourse.

Men of letters, says Baron Van Swieten, who lead a studious life, are on this account much exposed to apoplexy. At first they become languid; they delight in ease and indolence; their understanding grows dull; their memory decays and fails them; they then grow heavy, sleepy, and stupid, and often remain long in this wretched situation before they die. It has given me, he continues, much concern to see learned men of the first class, who had been very serviceable to literature, live more than a twelvemonth after the loss of their faculties, forget every thing; and at last die on a sudden.

Sure 'tis a curse which angry fates impose
To mortify man's arrogance, that those
Who're fashion'd of some better sort of clay,
Much sooner than the common herd decay.
O, galling circumstance to human pride!
Abasing thought, but not to be denied!
With curious art the brain, too finely wrought,
Preys on herself, and is destroy'd by thought.
Constant attention wears the active mind,
Blots out her pow'rs, and leaves a blank behind.

It was thus with Dean Swift, who was seized in 1736 with violent giddiness, which in a few years gradually deprived him of his reason, and he sunk at last into a speechless idiot, and in the latter end of October 1745, without even giving an alarm to his attendants, he expired. A man in possession of his reason would have wished for such a kind of dissolution, but the Dean was wholly insensible; he had not even the power or expression of a child, appearing, for some years before his death, the reverse of that fine description of man given us by Milton.

————————A being, who not prone
And brute as other creatures, but endu'd
With sanctity of reason, might erect
His stature, and upright with front serene
Govern the rest, self-knowing, and from thence
Magnanimous to correspond with heaven,
But grateful to acknowledge whence his good
Descends, thither with heart, and voice, and eyes,
Directed in devotion, to adore
And worship God supreme, who made him *chief*
Of *all his works.*

History affords us many very striking instances of the effect of mental agitation in disturbing the powers of the understanding.

A German lady of great beauty and accomplishments having married an Hessian officer, who was ordered to America, and not being able to acquire any tidings of him in her own country, came over to England. Here, she could only learn the destiny of her husband, from those ships which had either transported troops to the continent, or were bringing back the wounded. Day after day she wandered on the beach at Portsmouth, and hour after hour she wearied her eyes bedewed with tears in the vain expectation of seeing him. She was observed, at the same spot, ere it was light, and watched each motion of the waves until the setting sun. Then her haunted imagination presented him mangled with wounds, and the smallest gust of wind seemed to threaten her with an eternal separation. Did a ship enter into port, her eager steps led her to the spot, and many an enquiry was repaid with an insolent rebuff After eight months spent in this anxious manner, a ship arrived bringing her the melancholy pleasure, "that some Hessian officers, who were wounded, were on "their passage." Her impatience increased daily. A vessel at length arrived reported to have Hessian troops on board. She kept at some distance for fear of giving too great a shock to her husband's feelings, should he be among them. He was landed with others. She fainted, and he was conveyed, she knew not where. Having recovered, and going to the different inns, she found at last her husband. The master of the inn informed her, "he was very bad," and she begged that her being in England might be gradually broken to him. When she entered the room, he burst into a flood of tears. A lady was supporting him in her arms. What words, or painter, could represent the tragedy that followed! He had married in America, and this person was also his wife. He entreated "pardon," was passed reproach, for in a few minutes after he sunk into the arms of death. The lady whose melancholy history we are recording, rushed from the room, and leaving her clothes and money at her lodging, she wandered she knew not whither, vowing "that she would never enter house more, nor trust to man." She stopped at last near Bristol, and begged the refreshment of a little milk. There was something so attractive in her whole appearance as soon procured her whatever she requested. She was young, and extremely beautiful:—her manners graceful and elegant, and her countenance interesting to the last degree.—She was alone—a stranger—and in extreme distress;—she asked only for a little milk—but uttered no complaint, and used no art to excite compassion. Her dress and accent bore visible marks that she was a foreigner of superior birth. All the day she was seen wandering in search of a place to lay her wretched head; she scooped towards night a lodging for herself in an old hay-stack. Multitudes soon flocked around her in this new habitation, attracted by the novelty of the circumstance, her singular beauty, but above all the suddenness of her arrival. French and Italian were spoken to her, but she appeared not to understand these languages; however when she was accosted in German, she evidently appeared confused;—the emotion was too great to be suppressed, she uttered some faint exclamation in our tongue, and then, as if hurried into an imprudence, she attempted to be also without knowledge of this language. Various conjectures were instantly formed, but what seemed passing strange was her acceptance of no food, except bread or milk, and that only from the hands of females! On the men she looked with anger and disdain, but sweetly smiled as she accepted any present from the other sex. The neighbouring ladies remonstrated with her on the danger of so exposed a situation, but in vain, for neither prayers nor menaces could induce her to sleep in a house.

As she discovered evident mark of insanity, she was at length confined in a mad-house, under the care of Dr. Renaudet, physician at the Hot Wells. On the first opportunity she escaped, and repaired to her beloved hay-stack. Her rapture was inexpressible on finding herself at liberty, and once more safe beneath this miserable refuge.

Beneath a hay-stack Louisa's dwelling rose,
Here the fair maniac bore four winter's snows.
Here long she shiver'd, stiffening in the blast,
And lightnings 'round her head their horrors cast.

Dishevel'd, lo! her beauteous tresses fly,
And the wild glance now fills the staring eye:
The balls fierce glaring in their orbits move;
Bright spheres, where beam'd the sparkling fires of love,
Ill starr'd Louisa!

It was nearly four years that this forlorn creature devoted herself to this desolate life, since she knew the comfort of a bed, or the protection of a roof. Hardship, sickness, intense cold, and extreme misery, have gradually impaired her beauty, but she still is a most interesting figure; and there remains uncommon sweetness and delicacy in her air and manner; and her answers are always pertinent enough, except when she suspects the question is meant either to affront or ensnare her, when she seems sullen or angry. Some Quaker ladies at this time interposed, and Louisa, as she was called, was conveyed to Guy's Hospital, where, after remaining some years, she at length paid the debt to nature.

The person with whom she lodged, upon her death-bed, divulged the secret of the flight of this stranger from Portsmouth, which corresponds nearly with the time of her arrival near Bristol, and future enquirers have discovered, that she was "*the natural daughter of* FRANCIS *Emperor* "*of Germany*." Vide the Narrative of Facts respecting the Bristol Stranger, or the Maid of the Hay-stack. Printed for Gardner, Strand.

The page of history furnishes us with another instance equally terrible, when that system of government was established in France, during the continuance of which, to use the words of an eloquent member of the Convention, there was under every footstep a *spring-gun*, under every roof a *spy*, and in every family an *informer*, and on every bench of justice an *assassin*.

A small tree of liberty which had been planted on a solitary spot near Bedouin, was, during the night, torn from the ground by a wretch, who knew that this incident would furnish a pretext for pillage and devastation. At break of day the very person who was the perpetrator of this act, the president of one of those societies, which was the terror of all good citizens, being the combination only of the violent and worthless, sounded a general alarm, and accused the guiltless inhabitants of Bedouin of the sacrilege committed against the hallowed symbol of freedom.

Without further inquiry a municipal commission was immediately organized by Maignet, which presented itself for the hope of spoil. Revolutionary troops were instantly summoned to spread through the village and territory of Bedouin desolation and death. Five hundred habitations were delivered to the flames; the fruits of the harvest were consumed; and the mandate of Maignet, fatal as the sabled wand of an evil magician, struck the rich and luxuriant soil with sudden sterility. The flourishing silk manufactures of Bedouin shared also the fate of its desolated fields. The inhabitants, being unable to name the guilty persons, were all involved in one general proscription. Those who escaped the guillotine sought for shelter in the depths of caverns, after the conflagration of their habitations, on the ruins of which bills were affixed, forbidding any person to approach the spot.

Two hundred and eighty young men of Bedouin, who were clothed by the village, and had flown to the frontier even before the requisition in order to defend their country, in vain dispatch successive letters, pleading with fond solicitude for their parents. Those gallant young soldiers will return to their native village, their brows bound with the laurels of valour. Alas! they will find their native village but one sad heap of ruins!—in vain they will call upon the tender names of father, of mother, of sister:—

a melancholy voice will seem to issue from the earth that covers them, and sigh, they are no more! For those victorious warriors no car of triumph is prepared; no mother's tears of transport shall hail the blessed moment of their return; no father shall clasp them to his bosom with exulting joy, proud of their heroic deeds. Ah no! their toils, their dangers, and their generous sacrifices, shall find no recompense in the sweetness of domestic affection, in the soothing bliss which, after absence, belongs to home!—alas! their homes are levelled with the ground; they will find no spot upon which to repose their wearied limbs but the graves of their murdered parents.

Amidst the groans of so general a calamity, no doubt many a sigh of private sorrow has never reached the ear of sympathy, and many a victim has fallen unpitied and unknown. Some of the martyrs of Maignet's tyranny have however found the sad recorder of the pensive tale, and the fate of Monsieur de M——'s family is not among the least affecting of those scenes, which were extended over the district of Bedouin.

Mons. de M——, after wandering as far as his infirmities would permit, for he was old and sick, took refuge in a lonely habitation, a few leagues distant from Avignon, situate in one of the wildest parts of that romantic country; in that celebrated region, for ever dear to the lovers of the elegant arts, where the immortal Petrarch poured forth his impassioned strains. Divine poet! no more shall the unhappy lover seek for consolation in shedding delicious tears on the brink of that fountain where thou hast wept for Laura!—no more shall he haunt with pensive enthusiasm that solitary valley, those craggy rocks, those hanging woods, and torrent-streams, where thou hast wandered with congenial feelings, and to which thy tender complaints have given everlasting renown!—those enchanting dreams, those dear illusions, have for ever vanished—that delicious country, the pride of France, the garden of Europe, the classical haunt of Petrarch, no longer presents the delightful images of beauty, of poetry, of passion; the magical spell is broken, the soothing charm is dissolved; the fairy scenes have been polluted, the wizard bower profaned; the orange-groves are despoiled of their aromatic sweetness; the waters are tinged with blood; the hollow cliffs re-echo the moans of the wretched, and the shriek of despair; the guillotine has arisen amidst those consecrated shades where love alone had reared its altars! No longer with the name of Vaucluse is associated the idea of Petrarch; that of Maignet presents itself to the shuddering imagination. For here it was that Mons. de M—— sought for refuge, attempting to shelter himself from the rage of his ferocious persecutors.

He had soon after the anguish of hearing that his brother had perished on the scaffold.

Mons. de M—— sent to inform his sister-in-law of the place of his retreat, to which he conjured her to hasten with her only daughter, and share the little property which he had rescued from the general wreck of his fortune.

His old and faithful servant Marianne, who was the bearer of this message, returned, accompanied by his niece: her mother was no more: she had only survived a few days the death of her husband.

The interview between Mademoiselle Adelaide de M— and her uncle produced those emotions of overwhelming sorrow that arise at the sight of objects which interest our affections after we have sustained any deep calamity; in those moments the past rushes on the mind with uncontrollable vehemence; and Mademoiselle de M——, after having long embraced her uncle with agony, at length pronounced in the accents of despair the names of father and of mother.

Mons. de M—— endeavoured to supply to his unfortunate niece the place of the parents she had lost, and forgot his own evils in this attempt to soothe the affliction of this interesting mourner, who, at nineteen years of age, in all the bloom of beauty, was the prey of deep and settled melancholy.

She had too much sensibility not to feel his tender cares, and often restrained her tears in his presence because they gave him pain.

When those tears could no longer be suppressed, she wandered out alone, and, seating herself on some fragments of rock, soothed by the murmurs of the hollow winds, and moaning waters, indulged her grief without controul.

In one of those lonely rambles, sacred to her sorrows, she was awakened from melancholy musing by the sudden appearance of her cousin, the son of Mons. de M——, who, after having repeatedly exposed his life during a long and perilous campaign in the service of his country, returned to find his uncle sacrificed, his aunt dead, his father an exile, and his home burnt. Such were the rewards which the gallant defenders of liberty received from the hands of *tyrants*.

A few months before, he had beheld his lovely cousin in all the pride of youthful beauty; her cheek flushed with the gay suffusion of health, and her eye sparkling with pleasure. That cheek was now covered with fixed paleness, and that eye was dimmed with tears; but Mademoiselle de M—— had never appeared to him so interesting as in this moment.

Two young persons, placed together in such peculiar circumstances, must have had hearts insensible indeed, had they conceived no attachment for each other. The scene in which they were placed was peculiarly calculated to cherish the illusions of passion; not merely from displaying those simple and romantic beauties the contemplation of which softens while it elevates the affections—it had also that local charm which endears to minds of taste and sentiment spots which have been celebrated by the powers of genius. Petrarch, the tender, the immortal Petrarch, had trod those very vallies, had climbed those very rocks, had wandered in those very woods—and the two young persons, both understanding Italian, when they read together the melodious strains of that divine poet, found themselves transported into happier times, and forgot for a while that all beyond the narrow cleft was misery and disorder.

From those dreams, those delightful illusions, they were awakened by a letter, privately conveyed to him, conjuring him, if he would shun being classed among the proscribed, to repair immediately to the army.

Young de M—— considered the defence of his country against invaders as a sacred duty which he was bound to fulfil. He also thought it prudent to depart. He bid adieu to his father and Adelaide with tears wrung from a bleeding heart, and tore himself away with an effort which it required the exertion of all his fortitude to sustain.

After having passed the cleft, which enclosed the valley, he again turned back to gaze once more on the spot which contained all his treasure.

Adelaide, after his departure, had no consolation but in the sad yet dear indulgence of tender recollections; in shedding tears over the paths they had trod, over the books they had read together.

Alas! this unfortunate young lady had far other pangs to suffer than the tender repinings of absence from a beloved object!

Two proscribed victims of the tyranny of Maignet, who were friends to Mons. de M——, and knew of the place of his retreat, sought for an asylum in his dwelling.

Mons. de M—— received his fugitive friends with affectionate kindness. But a few days after their arrival their retreat was discovered by the emissaries of Maignet; the narrow part of the valley was guarded by soldiers; the house was encompassed by a military force; and Mons. de M—— was summoned to depart with the conspirators whom he had dared to harbour, in order to appear with them before the popular commission at Orange.

This last stroke his unhappy niece had no power to sustain. All the wounds of her soul were suddenly and rudely torn open; and altogether overwhelmed by this unexpected, this terrible calamity, which filled up the measure of her afflictions, her reason entirely forsook her.

With frantic agony she knelt at the feet of him who commanded the troop; she implored, she wept, she shrieked; then started up and hung upon her uncle's neck, pressing him wildly in her arms.

Some of the soldiers brutishly proposed conducting her also to the tribunal; but the leader of the band, whether touched by her distress, or fearful that her despair would be troublesome on the way, persuaded them to leave her behind.

She was dragged from her uncle, and locked in a chamber, from whence her shrieks were heard by the unfortunate old man till he had passed the narrow cleft of the valley, which he was destined to behold no more.

His sufferings were keen, but they were not of long duration. The day of his arrival at Orange, he was conducted before the popular commission, together with his friends, and from thence immediately led to execution.

In the mean time, Mademoiselle de M——, released by

Marianne from the apartment where she had been confined by the merciless guards, wandered from morning till evening amidst the wildest recesses of the valley, and along the most rugged paths she could find.

She was constantly followed in her ramblings by her faithful servant, who never lost sight of her a single moment, and who retains in her memory many a mournful complaint of her disordered mind, many a wild expression of despair.

She often retired to a small nook near the torrent, where her uncle had placed a seat, and where he usually passed some hours of the day.

Sometimes she seated herself on the bench; then starting up, and throwing herself on her knees before the spot where her uncle used to sit, bathed it with floods of tears. " Dear old man," she would cry, " your aged head! Poor Charles!—It is well he's gone.—I see the guillotine behind those trees;—now they drag up the weak old man!—they tie him to the plank!—oh, heavens!"

The acute affliction with which young De M—— heard of the murder of his father, was still aggravated by the tidings he received from Marianne of the situation of his beloved Adelaide. Her image was for ever present to his mind; and, unable to support the bitterness of those pangs which her idea excited, he again found means to obtain leave of absence for a few weeks, and hastened to the valley.

He found the habitation deserted—all was dark and silent: he flew through the apartments calling upon the name of Adelaide, but no voice answered his call.

He left the house, and walked with eager steps along the valley. As he passed a cavern of the rocks, he heard the moans of Adelaide. He rushed into the cavern. She was seated upon its flinty floor, and Marianne was sitting near. Adelaide cast up her eyes as he entered, and looked at him earnestly—he knelt by her side, and pressed her hand to his bosom—" If you are Charles," says she, " you are come too late—it is all over!—Poor old man!" Then hastily rising from the ground, and clasping her hands together, she cried, " Don't you see his blood on my clothes?—I begged very hard for him—I told them I had no father or mother, but him. If you are really Charles, fly, fly!—they are on the way—I see them on the rock!—there, there!"

Such were the ravings of the disordered imagination of this unfortunate young lady, and which were sometimes interrupted by long intervals of silence, and sometimes by an agony of tears. Her lover watched over her with the most tender and unwearied assiduity; but his cares were ineffectual. The life of Adelaide was near its close. The convulsive pangs of her *mind* had reduced her frame to a state of incurable weakness and decay.

A short time before she expired, she recovered her reason, and employed her last remains of strength in the attempt to console her wretched lover. She spoke to him of " a happier world, where they should meet again, and where tyrants would oppress no more." She grasped his hand—she fixed her eyes on his—and died.

Young De M—— passed the night at the grave of Adelaide. Marianne followed him thither, and humbly entreated him to return to the house. He pointed to the new-laid earth, and waved his hand, as if he wised her to depart, and leave his meditations uninterrupted.

The next morning, at break of day, he entered the house, and called for Marianne. He thanked her for her care of Adelaide, and presented her with a purse of money; while he was speaking, his emotion choaked his voice, and for the first time his oppressed heart found the relief of tears.

When he had recovered himself, he bade Marianne farewell, and hastened out of the house, muttering something in a low tone. He told Marianne, that he was going to join his regiment,—but has never been heard of since.

Far in the windings of a vale,
  Fast by a sheltering wood,
The safe retreat of health and peace,
  A humble cottage stood.

There beauteous Emma flourish'd fair
  Beneath a mother's eye,
Whose only wish on earth was now
  To see her blest, and die.

The softest blush that Nature spreads,
  Gave colour to her cheek ;
Such orient colour smiles through Heav'n
  When May's sweet mornings break.

Nor let the pride of great ones scorn
  The charmer of the plains ;
That sun which bids their diamond blaze,
  To deck our lily deigns.

Long had she fir'd each youth with love,
  Each maiden with despair ;
And though by all a wonder own'd,
  Yet knew not she was fair.

'Till Edwin came, the pride of swains,
  A soul that knew no art,
And from whose eyes serenely mild,
  Shone forth the feeling heart.

A mutual flame was quickly caught,
  Was quickly too reveal'd ;
Nor neither bosom lodg'd a wish
  Which virtue keeps conceal'd.

What happy hours of heart-felt bliss
Did love on both bestow!
But bliss too mighty long to last,
Where fortune proves a foe.

The father was a sordid man,
Who love nor pity knew,
Was all unfeeling as the rock
From whence his riches grew.

Long had he seen their mutual flame,
And seen it long unmov'd;
Then with a father's frown at last,
He sternly disapprov'd.

In Edwin's gentle heart a war
Of differing passions strove;
His heart, which durst not disobey,
Yet could not cease to love.

Deny'd her sight, he oft behind
The spreading hawthorn crept,
To snatch a glance, to mark the spot
Where Emma walk'd and wept.

Oft too in Stanemore's wintry waste,
Beneath the moonlight shade,
In sighs to pour his soften'd soul,
The midnight mourner stray'd.

His cheeks, where love with beauty glow'd,
A deadly pale o'ercast;
So fades the fresh rose in its prime,
Before the northern blast.

The parents now, with late remorse,
Hung o'er his dying bed,
And wearied Heav'n with fruitless pray'rs,
And fruitless sorrows shed.

"'Tis past," he cried, "but if your souls
"Sweet mercy yet can move,
"Let these dim eyes once more behold
"What they must ever love."

She came; his cold hand softly touch'd,
And bath'd with many a tear;
First falling o'er the primrose pale
So morning dews appear.

Now homeward as she hopeless went,
The church-yard path along,
The blast blew cold, the dark owl scream'd
Her lover's fun'ral song.

Amid the falling gloom of night,
Her startling fancy found
In ev'ry bush, his hovering shade,
His groan in every sound.

Alone, appall'd, thus had she pass'd
The visionary vale,
When lo! the *death-bell* smote her ear,
Sad sounding in the gale.

Just then she reach'd, with trembling steps,
Her aged mother's door!
"He's gone," she cried, "and I shall see
"That angel face no more!

"I feel, I feel this breaking heart
"Beat high against my side:"
From her white arm down sunk her head,
She shiver'd, sigh'd, and *died.*

A certain English clergyman, eminent for his accomplishments, who had spent many years in travelling with a young nobleman, took up, at length, his residence in the neighbourhood of a great town, at the seat of his young pupil. He then entertained the firm persuasion, "that true felicity and virtue consist in uniformly subjecting all the passions to the dictates of the understanding." His ardour for knowledge, and the constant succession of new objects, which naturally resulted from his ambulatory mode of existence, had hitherto rendered it no very difficult matter to realize this truth. But the moment he was settled, his mind began to vary with the scene. Where so many objects solicited his attention at the same time, some were unavoidably preferred. A fine garden, delightful arbours, a beautiful sheet of water, streams, cascades, grottos, wildernesses, large fields, delicious woods, and extensive plains, engrossed at first his whole attention. The united charms of such rural and enchanting scenes were his evening and morning amusement. Wherever he went on business or pleasure, he still felt a secret impulse recalling his affections to the spot, where all his happiness naturally centered. Even here, however, like the first man in the bosom of paradise, he was soon far from being completely blessed. No longer absorbed in other pursuits, he sighed insensibly for a companion to share his enjoyments. Now, if a spotless maiden should appear; all innocence, and all soul; all love, and of love all worthy; if in her large arched forehead all the capacity of immeasurable intelligence, which wisdom can communicate be visible; if her compressed, but not frowning eye-brows speak an unexplored mine of understanding, or her dimpled cheek sympathetic goodness of heart, which flows through the clear teeth, over her pure and efficient lips; if she breathe humility and complacency; if dignified wisdom be in each tone of her voice; if her eyes, neither too open nor too close, often gently turned, speak the soul, that seeks a sisterly embrace; if she be superior to the powers of description; if all the glories of her angelic form be imbibed like the mild and golden rays of an autumnal evening sun;

what do you think would become of our philosopher, and of his sublime theory?

Near this retirement, there chanced to reside a lady of most exquisite beauty; but, alas! she had not that sanctity of innocence, that divinity of maiden purity before described, but wiles affecting every look of modesty. She possessed the wretched pride of silence, a measured affectation of speech, eyes arrogantly overlooking misery and poverty, an authoritative nose, and lips blue with envy, or half bitten through from artifice or malice. The elegance of her person soon, however, attracted the attention of the philosopher, and fancying the mind must correspond, through the medium of a friend he obtained an interview. This lady, who was so well able to put on the mask, listened with attention to his discourse, and seemed eager to cultivate his acquaintance. Not insensible of the conquest she had made, she diverted her female friends with the tender sensibility of the *poor fool*, her lover, as she used to style him. This coquetry being managed with address, was nicely calculated to operate on an easy and unsuspecting mind.

Imagine now the sensibility of the philosopher, who had singled out the fair by the kindest partiality, when assured she had all along regarded him with a similar emotion. His happiness became inseparable from hers. He soon, however, experienced all those teasing perplexities which the artifice of a cunning woman was able to contrive. The triumph of conquest was her only aim. So capricious and evanescent appeared the attachment of an inconsiderate and giddy mind. The impression on such, like those made on a stream by the gentlest breeze, exist but for a moment: far otherwise the attachment of the feeling, the susceptible, and the pensive. How infinitely more durable the tender sensibilities he indulged! He possessed, however, too much good sense not to see through her duplicity; and to discover that she was trifling with the sensibilities of a heart, which thousands would have soothed and cherished with joy; yet to tear from his bosom all at once its dearest object on earth, occasioned the most serious and inexpressible concern. The struggle was indispensable, and competent to all his philosophy. It was reason asserting her supremacy over passion, and heaven striving for the mastery over man. At this interval, the lady removed the mask, and married a wild fortune-hunter, who soon brought her into contempt and wretchedness.

Happy would it have been for our philosopher, could his wounded mind have been restored to its former health and tranquillity. But his heart was gone, and with it all relish for life. It was not henceforward in the power of medicine, variety, or expedient, to afford him the least interval of serenity. His nights and his days were alike dreary and joyless. The scenes, which had been the witnesses of his happier hours, now became the constant and solitary companions of his wretchedness. At last, overwhelmed with thought, the brain sunk lethargic, and the philosopher was converted into the happier ideot, until *death* soon, fortunately, closed the melancholy and degrading scene.

Savage, that unfortunate genius, born, as he says,

Of a mother, and yet no mother!

who, after he had been allowed £200 *per annum* by Lord Tyrconnel, which was taken unjustly from him; after he was pensioned by the Queen, on whom he had written verses, and the pension ceased at her demise; after having tired his friends, who feared to acknowledge him, on account of his shabby dress, so expressive of his circumstances, being at length arrested and thrown into Newgate, for the small sum of eight guineas, he bore this last misfortune with uncommon fortitude. Six months elapsed in prison, when he received a letter from Mr. Pope, on whose kindness he had the greatest confidence, and to whom he applied, charging him with *ingratitude*, drawn up in such terms as resentment dictated. Mr. Savage returned an answer, proving his innocence from the charge. The accusation, however, strongly affected his mind: he became immediately *melancholy*, and in a few days afterwards was seized with pains in his back and loins, which not being violent, he was not suspected to be in danger; but daily growing more languid and *dejected*, on the 20th of July a fever seized upon his spirits. The last time the keeper saw him was on July the 31st, when Savage, seeing him at his bed-side, said, with uncommon earnestness,—"I have something to say to you, Sir;" but after a pause, moved his hand in a melancholy manner, and finding himself unable to recollect what he was going to communicate, added, "It is over." The keeper soon after left him; and the next morning he was found *dead*.

Churchill is said to have killed Hogarth by the stroke of his pen. The painter made a caricature of Churchill, and he in return wrote a satire on Hogarth. He thus describes him:—

Pale quiv'ring lips, lank cheeks, and fault'ring tongue,
The spirits out of tune, the nerves unstrung,
Thy body shrivelled up, thy dim eyes sunk
Within their sockets deep, thy weak hams shrunk,
The body's weight unable to sustain,
The stream of life scarce trembling through the vein,
More than *half-kill'd* by honest truths, which fell
Through thy own fault, from men who wish'd thee well;
Canst thou, e'en thus, thy thoughts to vengeance give,
And, dead to all things else, to malice live?

Hence, dotard, to thy closet, shut thee in,
By deep repentance wash away thy sin,
From haunts of men to shame and sorrow fly,
And, in the verge of death, learn how to die.
Vain exhortation! Wash the Æthiop white,
Discharge the leopard's spots, turn day to night,
Controul the course of nature, &c.——
Thou wretched being, whom, on Reason's plan,
So chang'd, so lost, I cannot call a man,
What could persuade thee, at this time of life,
To launch afresh into the sea of strife?
Better for thee, scarce crawling on the earth,
Almost as much a child as at thy birth,
To have resign'd in peace thy parting breath,
And sunk unnoticed in the arms of death.
Now, by my soul, it makes me blush to know
My spirits could descend to such a foe.
&c. &c.

Hogarth did not *long survive* this satire.

A widow lady, who lost an affectionate husband, an officer, was left in narrow circumstances, with a boy and girl, two beautiful and lively children, the one five and the other seven years of age; as her circumstances allowed her to keep but one maid-servant, the two children were the sole attention, employment, and consolation of her life; she fed them, dressed them, slept with them, and taught them herself. They were both snatched from her by a putrid sore throat in one week; so that the poor woman lost, at once, all that employed her, as well as all that was dear to her. For the first three or four days after their death, when any friend visited her, she sat upright, with her eyes wide open, without shedding tears, and without utterance. Afterwards she began to weep much, and soon incessantly talked of nothing but of her dear children. Bereaved of all that made existence pleasant, a heavy gloom settled upon her mind, and her body became in consequence daily more emaciated and weak. These, indeed, are evils too terrible for the weakness of humanity to bear, and which admit of no remedy but *the grave*!

Outrageous did the loud winds blow
Across the sounding main;
The vessel, tossing to and fro,
Could scarce the storm sustain.

Matilda to her fearful breast
Held close her infant dear:
His presence all her fears increas'd,
And wak'd the tender tear.

Now nearer to the grateful shore
The moving vessel drew:
The daring waves now ceas'd to roar,
Now shout th' exulting crew.

Matilda, with a mother's joy,
Gave thanks to Heaven's pow'r:
How fervent she embrac'd her boy!
How blest the saving hour!

Oh! much deceiv'd and hapless fair,
Though ceas'd the waves to roar,
Thou, from that fatal moment, ne'er
Can'st taste of pleasure more.

For, stepping forth from off the deck,
To reach the welcome ground,
The babe, unclasping from her neck,
Plung'd in the gulph profound.

Amazement chain'd! her haggard eye
Gave not a tear to flow,
Her bosom heav'd no conscious sigh,
She stood a sculptur'd woe.

To snatch the child from instant death,
Some brav'd the threat'ning main,
And to recall his fleeting breath
Try'd ev'ry art in vain.

But when the corse first met her view,
Stretch'd on the pebbly strand,
Rous'd from her ecstasy she flew,
And pierc'd th' opposing band.

With tresses discompos'd and rude,
Fell prostrate on the ground;
To th' infant's lips her lips she glew'd,
And sorrow burst its bound.

Now throwing round a troubled glance;
With madness' ray inflam'd,
And, breaking from her silent trance,
She wildly thus exclaim'd:

"Oh! Oh! his little life is fled,
"His heaveless breast is cold;
"What tears will not the mother shed,
"When thy sad tale is told!

"Ah me! that cheek of livid hue—
"That brow—that auburn hair—
"Those lips where late the roses blew,
"All, all my son declare."

She added not—but sunk oppress'd—
Death on her eye-lids stole,
While from her grief-distracted breast
She sigh'd her tortur'd soul.

SECTION LIII.

LAW III.

A DEFECTIVE EXCITEMENT OF THE MIND ACCUMULATES NERVOUS ENERGY, WHILE IT AT THE SAME TIME WEAKENS THE NERVES.

Having treated of direct nervous stimuli, and their effect in strengthening the powers of the understanding, when in due quantity, and their baneful effect when in excess, and having shewn that the nervous system was, in this respect, obedient to nearly the same laws as the fibrous, we are arrived now at that part of our subject which treats of indirect nervous stimuli, which like other indirect stimuli, accumulates nervous energy.

That the nervous power is accumulated by defect of sensorial action, we have the most striking example in vision. It is, indeed, surprising how far the eye can accommodate itself to darkness, and make the best of a gloomy situation. When first taken from light and brought into a dark room, all things disappear; but after a few minutes the pupil dilates, and the optic nerve having accumulated sufficient sensorial power many objects may be discerned.

Xenophon, in his account of the retreat of the ten thousand, mentions that the Persians and Greeks had always lights in their camps: but as they traversed Thrace, the king Seuthes had lights around his camp, which kept him concealed, and enabled him to perceive any person who should have the boldness to reconnoitre his camp, whereas the Persians and Greeks could only discover the spy in the camp itself.—The reason of this is explained by the principle above.

There was a gentleman of great courage and understanding, who was a major under King Charles I. This unfortunate man, sharing in his master's misfortunes, and being forced abroad, ventured, at Madrid, to do his king a signal service; but, unluckily, failed in the attempt. In consequence of this, he was instantly ordered to a dark and dismal dungeon, into which the light never entered, and into which there was no opening but by a hole at the top, down which the keeper put his provisions, and presently closed it again on the other side. In this manner the unfortunate loyalist continued for some weeks, distressed and disconsolate; but, at last, began to think he saw some little glimmering of light. This internal dawn seemed to increase from time to time, so that he could not only discover the parts of his bed, and such other large objects, but, at length, he even began to perceive the mice that frequented his cell, and saw them as they ran about the floor, eating the crumbs that happened to fall. He formed here an acquaintance with a spider, whose motions he observed, which was his chief amusement. After some months in this confinement he was set at liberty; but such was the effect of the darkness, and so great the accumulated irritability of the optic nerve, that he was obliged to remain shut up for some time after, and accustom himself by degrees to the light.

SECTION LIV.

GRIEF.

Othello sets sail with Desdemona for Cyprus, when a violent storm arises. They however arrive safe. Enter Othello.

Oth. Oh, my fair warrior!
Des. My dear *Othello.*
Oth. It gives me wonder, great as my *content,*
To see you here before me. O my soul's joy!

If *after every tempest* comes *such calms*,
May the winds blow till they have weaken'd death :
And let the labouring bark climb hills of seas
Olympus high ; and duck again as low
As hell's from heav'n ; if I were *now* to die,
'Twere now to be *most happy ;* for I fear
My soul hath her *content so absolute,*
That not another comfort like to this
Succeeds in unknown fate.

Livy relates, that two women, who supposed their sons dead, upon seeing them return unhurt, after the battle of Thracymene, died from excess of emotion. One, says he, at the very gate, being surprised at the sudden arrival of her son, expired in his arms ; the other, to whom the death of her son had been falsely announced, sorrowing at the step of her house, died upon seeing her son return alive.

SECTION LV.

SURPRISE.

Iræ amuntium amoris integratio est.*

Angelina. " Turn, gentle Hermit of the dale,
" And guide my lonely way
" To where yon taper cheers the vale
" With hospitable ray.

" For here forlorn and lost I tread,
" With fainting steps and slow ;
" Where wilds, immeasurably spread,
" Seem length'ning as I go."

The Hermit. " Forbear, my son," the Hermit cries,
" To tempt the dangerous gloom ;
" For yonder faithless phantom flies
" To lure thee to thy doom.

* Amantium pro-fa. [illegible]

"Here to the houseless child of want
"My door is open still;
"And though my portion is but scant,
"I give it with good will.

"Then turn to-night, and freely share
"Whate'er my cell bestows;
"My rushy couch and frugal fare,
"My blessing and repose.

"No flocks, that range the valley free,
"To slaughter I condemn:
"Taught by that Power that pities me,
"I learn to pity them:

"But from the mountain's grassy side
"A guiltless feast I bring;
"A scrip with herbs and fruits supply'd,
"And water from the spring.

"Then, pilgrim, turn, thy cares forego;
"All earth-born cares are wrong:
"Man wants but little here below,
"Nor wants that little long."

Soft as the dew from heaven descends,
His gentle accents fell:
The modest stranger lowly bends,
And follows to the cell.

Far in a wilderness obscure
The lonely mansion lay;
A refuge to the neighb'ring poor,
And strangers led astray.

No stores beneath its humble thatch
Requir'd a master's care;
The wicket, op'ning with a latch,
Receiv'd the harmless pair.

And now, when busy crowds retire
To take their evening rest,
The Hermit trimm'd his little fire,
And cheer'd his pensive guest:

And spread his vegetable store,
And gaily prest, and smil'd;
And, skill'd in legendary lore,
The lingering hours beguil'd.

Around, in sympathetic mirth,
Its tricks the kitten tries;
The cricket chirrups in the hearth;
The crackling faggot flies.

But nothing could a charm impart
To soothe the stranger's woe;
For grief was heavy at his heart,
And tears began to flow.

His rising cares the Hermit spy'd,
With answering care opprest:
The Hermit. "And whence, unhappy youth!" he cry'd,
"The sorrows of thy breast?

"From better habitations spurn'd,
"Reluctant dost thou rove:
"Or grieve for friendship unreturn'd,
"Or unregarded love?

"Alas! the joys that fortune brings,
"Are trifling and decay:
"And those who prize the paltry things,
"More trifling still than they.

"And what is *friendship* but a name,
"A charm that lulls to sleep;
"A shade that follows wealth or fame,
"And leaves the wretch to weep?

" And *love* is still an emptier sound,
" The haughty fair-one's jest:
" On earth unseen, or only found
" To warm the turtle's nest.

" For shame, fond youth, thy sorrows hush,
" And spurn the sex," he said:
But while he spoke, a *rising blush*
His *love-lorn* guest *betray'd.*

Angelina. " And, ah, forgive a stranger rude,
" A wretch forlorn," *she* cry'd;
" Whose feet unhallow'd thus intrude
" Where heaven and you reside.

" But let a maid thy pity share,
" Whom love has taught to stray;
" Who seeks for rest, but finds despair
" Companion of her way.

" My father liv'd beside the Tyne,
" A wealthy lord was he;
" And all his wealth was mark'd as mine,
" He had but only me.

" To win me from his tender arms,
" Unnumber'd suitors came;
" Who prais'd me for imputed charms,
" And felt or feign'd a flame.

" Each hour a mercenary crowd
" With richest proffers strove:
" Among the rest young Edwin bow'd,
" But never talk'd of love.

" In humble, simplest habit clad,
" No wealth or power had he;
" An honest heart was all he had,
" But that was all to me.

" The blossom opening to the day,
" The dews of heaven refin'd,
" Could nought of purity display,
" To emulate his mind.

" The dew, the blossoms of the tree,
" With charms inconstant shine;
" Their charms were his, but, woe to me,
" Their constancy was mine.

" For still I try'd each fickle art,
" Importunate and vain;
" And while his passion touch'd my heart,
" I triumph'd in his pain.

" Till, quite dejected with my scorn,
" He left me to my pride;
" And sought a solitude forlorn
" In secret, where he dy'd.

" But mine the sorrow, mine the fault,
" And well my life shall pay;
" I'll seek the solitude he sought,
" And stretch me where he lay.

" And there forlorn, despairing hid,
" I'll lay me down and die;
" 'Twas so for me that Edwin did,
" And so for him will I."

Hermit " Forbid it heaven!" the Hermit cry'd,
And clasp'd her to his breast:
The wondering fair-one turn'd to chide
'Twas Edwin's *self that prest**.

Edwin. " Turn, Angelina, ever dear,
" My charmer, turn to see
" Thy own, thy long-lost Edwin here,
" Restor'd to love and thee.

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* The passion the painter would endeavour to express *here* would be ECSTASY, or joy heightened by the contrary passion.

"No, never, from this hour to part,
"We'll live and love so true;
"The sigh that rends thy constant heart,
"Shall break thy Edwin's too."

SECTION LVI.

ABSENCE.

Rochefocault has very well remarked, that *absence* destroys weak passions, but increases strong, as the wind extinguishes a candle, but blows up a fire. Long *absence* naturally weakens the idea, and diminishes the passion* : but where the affection is so strong and lively as to support itself, the uneasiness arising from *absence*, says Hume, certainly increases the passion, and gives it new force and influence.

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* Absence may be too long, and then, instead of being an *indirect stimulus*, will exhibit its *sedative effect*. Hence people go abroad to overcome the passion of love; or,

As when some youth of firm and constant mind,
Who long in climes remote had absent pin'd;
And, after many a year of toil and care,
Returns impatient to review the fair,
Whom still he hopes to find the same
Fresh blooming object of his youthful flame;
But sees, alas! that time's relentless pow'r
Has chang'd the blossom to a faded flow'r;
For radiant locks, that wav'd in ringlets gay,
Sees rugged tresses verging fast to gray;
For eyes whose glance illumin'd all around,
Dull lifeless lamps, in wat'ry dimness drown'd;
For cheeks, which glow'd with beauty's rosy pride,
A wan complexion, and a shrivell'd hide——
One tender word he scarce has pow'r to say,
But turns with *horror* from the sight away.

Thomas. Let fops pretend in flames to melt,
And talk of pangs they never felt:
I speak without disguise or art,
And with my hand bestow my heart.

Sally. Let ladies prudishly deny,
Look cold, and give their thoughts the lie;
I own the passion in my breast,
And long to make my lover blest.

Thomas. *For this the sailor on the mast,*
Endures the cold and cutting blast,
All dripping wet wears out the night,
And braves the fury of the fight.

Sally. *For this the virgin pines and sighs,*
With throbbing heart, and streaming eyes,
Till sweet reverse of joy *she proves,*
And clasps the faithful lad she loves.

SECTION LVII.

PRETENDED ANGER.

Poor artless maid! to stain thy spotless name,
Expence and art, and toil, united strove;
To lure a breast that felt the purest flame,
Sustained by virtue, but betray'd by love.

School'd in the science of love's mazy wiles,
He cloth'd each feature with *affected scorn;*
He spoke of *jealous doubts,* and *fickle smiles,*
And, feigning, left her *anxious* and *forlorn.*

Then, while the FANCY'D RAGE alarm'd *her care,*
Warm to deny, and zealous to disprove;
He bade his words the WONTED SOFTNESS *wear,*
And seiz'd the minute of RETURNING LOVE.

Six envious moons matur'd her growing shame;
As yet to flaunt it in the face of day;
When scorn'd of virtue, stigmatiz'd by fame,
Low at his feet desponding JESSY lay.

" HENRY," she said, " by thy dear form subdu'd,
" See the sad relics of a nymph undone!
" I find, I find this rising sob renew'd,
" I sigh in shades, and sicken at the sun.

" Amid the dreary gloom of night, I cry,
" When will the morn's once pleasing scenes return?
" Yet what can morn's returning ray supply,
" But foes that triumph, or but friends that mourn?

" Alas! no more that joyous morn appears
" That led the tranquil hours of spotless fame!
" For I have steep'd a father's couch in tears,
" And ting'd a mother's glowing cheek with shame.

" The vocal birds that raise their matin strain,
" The sportive lambs increase my pensive moan;
" All seem to chase me from the cheerful plain,
" And talk of mirth and innocence alone.

" If thro' the garden's flow'ry tribes I stray,
" Where blooms the *Jasmin* that could once allure,
" Hope not to find delight in us, they say,
" For we are spotless, JESSY; we are pure.

" Now the grave old alarm the gentler young;
" And all my name's abhorr'd contagion flee;
" Trembles each lip, and falters every tongue,
" That bids the morn propitious smile on me.

" Thus, for your sake, I shun each human eye;
" I bid the sweets of blooming youth adieu;
" To die I languish, but I dread to die,
" Lest my sad fate should nourish pangs for you.

"Raise me from earth; the pains of want remove,
"And let me silent seek some friendly shore;
"There only, banish'd from the form I love,
"My weeping virtue shall relapse no more."

She spoke,—but he was born of savage race,
Nor would his hands a niggard boon assign;
He left her—torn from every earthly friend;
Oh! his hard bosom, which could bear to leave!

"Yes, I will go, where circling whirlwinds rise,
"Where threat'ning clouds in sable grandeur lower;
"Where the blasts yell, the liquid columns pour,
"And madd'ning billows combat with the skies;

"Oh! dreadful solace to the stormy mind!
"To me more pleasing than the valley's rest;
"For in despair alone, the wretched find
"That unction sweet which lulls the bleeding breast!"

Brief let me be; the fatal storm arose;
The billows raged; the pilot's art was vain;
From the tall rock, which circling surges close,
Headlong she leapt, and ended all her pain.

SECTION LVIII.

RESTRAINT.

To the happiness of our first years, nothing more seems necessary than freedom from restraint. Every man must remember, that when he was left to himself, and indulged in the disposal of his own actions, he was content, without the addition of any other enjoyment than freedom. Liberated from the shackles of discipline, he looks abroad into the world with rapture; he sees an Elysian region open before him, so variegated with beauty, and filled with good, that his heart overflows with delight. But the clock strikes; the school hour is come: what an alteration! In a moment his eyes lose their fire, his cheerfulness is at an end: farewell to joy and play. A severe and crabbed master takes him by the hand, and saying, gravely and sharply, *Come, sir,* forces him away. The chamber he is led into is furnished with books, and the poor lad suffers himself to be dragged thither, casting in silence an eye of regret on every object around him, the orbits swimming in tears he dare not shed, and his heart swelling with sighs he dare not vent. We will suppose two of these scholars broke loose from school. They will, I am positive, do more mischief in a country village than all the boys of the parish. Shut up one of these young gentlemen with the son of a peasant of the same age; and the first will have broken, or turned all the moveables in the room topsy turvy, before the latter has even stirred from his chair.

It is observed by Sir William Hamilton, in his account of an irruption of Mount Vesuvius, that the boys and the nuns seemed to be the only persons who felt *happy* among the sufferers from this dreadful calamity. The prancing of a horse, when first turned out into a field, depends upon the same general principle.

SECTION LIX.

CAPTIVITY.

Soon after the execution of the tyrant Robespierre, the committee of general safety appointed a deputation of its members to visit the prisons, and speak the words of comfort to the prisoners. In the mean time orders for liberty arrived in glad succession; and the prisons of Paris so lately the abodes of hopeless misery, now exhibited scenes which an angel might have contemplated with ecstasy. Upon the fall of the republican tyrant, the terrible spell which bound the land of France was broken; the shrieking whirlwinds, the black precipices, the bottomless gulphs, suddenly vanished. The generous affections, the tender sympathies, so long repressed by the congealing stupefaction of terror, burst forth with uncontroulable energy; and the enthusiasm of humanity took place of the gloomy terror of despair, as suddenly as when the winter's ice dissolves in the clear sunshine, or that luminary assumes its effulgence after an eclipse.

The first persons released from the Luxembourg were Monsieur and Madame Bitauby, two days after the fall of Robespierre. When they were liberated, the prisoners, to the amount of nine hundred persons, formed a lane to see them pass; they embraced them, they bathed them with tears, they overwhelmed them with benedictions, they hailed with transport the moment which gave themselves the earnest of returning freedom: but the feelings of *such moments* may be imagined but cannot be described. Crowds of people were constantly assembled at the gates of the prisons, to enjoy the luxury of seeing the prisoners snatched from their living tombs, and restored to freedom: that very people, who, when they first shook off their yoke of regal dominion, had committed every excess, and afterwards beheld, with stupid silence, the daily work of death under new rulers, now melted into tears over the sufferers, and filled the air with the loudest acclamations at their release. Paris was converted into a scene of enthusiastic transport. The theatres, the public walks, the streets, resounded with the songs of rejoicing; the people indulged themselves in all the frolic gaiety which belongs especially to their character; whilst the transport of the prisoners choaked the voice of utterance.

SECTION LX.

ANTITHESIS.

From immense pains **Demosthenes** became—the copious—the nervous—the majestic—orator,—who possesses the powers of elocution in their full extent.

This is the man whose enchanting and diffusive language was so much admired by listening nations, that they tamely suffered eloquence to rule the world;—but an eloquence whose course is rapid and sonorous!—an eloquence which every one gazes at and admires, and despairs to equal!

This is the eloquence that bends and sways the passions!

This the eloquence that alarms and soothes them at her pleasure!

This the eloquence that sometimes tears up all before it like a whirlwind; and at other times steals imperceptibly upon the senses, and probes to the bottom of the heart! The eloquence which ingrafts opinions that are new, and eradicates the old, and *such* was the eloquence of this great orator!

Imagine to yourself **Demosthenes** addressing the most illustrious assembly in the world, upon a point whereon the fate of the most illustrious of nations depended. How awful such a meeting! How vast the subject! Is any man possessed of talents adequate to the great occasion? Adequate—yes, superior: but it is by means of *Antithesis.* "I beheld Philip," says Demosthenes, "he "with whom was your contest, resolutely, while in pur-"suit of empire and dominion, exposing himself to every "wound; his eye gored, his neck wrested, his arm, his "thigh pierced; whatever part of his body fortune should "seize on, that cheerfully relinquishing; provided that, with "what remained, he might live with honour and renown.-"And shall it be said, that *he*, born in Pella, a place hereto-"fore mean and ignoble, should be inspired with so high "an ambition and thirst for fame, while *you*, Atheni-"ans!!" &c. Thus Demosthenes, by the organs of his body, attuned to the exertions of the mind, through the kindred organs of the hearers, instantaneously, and, as it were, with an electrical spirit, vibrates those energies from soul to soul.—Notwithstanding the diversity of minds in such a multitude, by the lightning of eloquence, they are melted into one mass—the whole assembly, actuated in one and the same way, become, as it were, one man, and have but one voice.—The universal cry is—"Let us march "against Philip—let us fight for our liberties—let us con-"quer—or die!"

Hannibal having assembled together all his forces, previous to the battle of Ticinus, he brought before them the young prisoners, whom he had taken among those barbarians that had disturbed his march across the Alps. With a view to the design which he now put in practice, he had before given orders, that these men should be treated with the last severity. They were loaded with heavy chains; their bodies were emaciated with hunger; and mangled by blows and stripes. In this condition, he now placed them in the midst of the assembly; and threw before them some suits of Gallic armour, such as their kings are accustomed to wear when they engage in single combat. He ordered some horses also to be set before them; and military habits, that were very rich and splendid. He then demanded of the young men, "which of them were willing to try their fate "in arms against each other; on condition that the conqueror should possess those spoils that were before their "eyes, while the vanquished would be released by death "from all his miseries." The captives, with one voice, cried out, and testified the utmost eagerness to engage. Hannibal then commanded, "that lots should be cast "among them: and that those two, upon whom the lot "should fall, should take the arms that were before them, "and begin the combat." When the prisoners heard these orders, they extended their hands towards the heavens; and every one most fervently implored the gods, that the lot to fight might be his own. And no sooner was their chance decided, than those whose fortune it was to engage, appeared filled with joy, while the rest were mournful and dejected. When the combat was also determined, the captives, that were by lot excluded the trial, pronounced "him who had lost his life in the engagement to be, in "their sight, not less happy than the conqueror: since, "by dying he was released from all that wretchedness, "which they were still doomed to suffer." The same reflections arose also in the minds of the Carthaginian soldiers; who, from comparing the condition of the dead with the ill fate of those that were led back again to chains and torture, declared "the former to be happy," and gave "their pity" to the sufferings of the latter.

When Hannibal perceived that this contrivance had produced in the minds of all the army the effect that was intended from it, he came among the soldiers, and then addressed them as follows: "I have offered this spectacle "to your view, that, when you have discerned your own "condition in the fate of those unhappy captives, you "might more clearly judge what resolutions were most "proper to be taken, and in what manner you might best "form your conduct in the present circumstances. For, "in the combat which you have seen, and the prize pro-"posed to the conqueror, is displayed a perfect image of "that state into which you yourselves are now brought by "fortune. Such indeed is your situation, that you must "either conquer,—or be slain in battle,—or else fall alive "into the power of your enemies. By *conquest*, you will "obtain a prize not of horses and military habits, but "the whole wealth and riches of the Roman empire; and "will then become the happiest of mankind: and if you "were to *fall* in battle, you will then only die; without "being first exposed to any kind of misery; and contend-"ing, to your latest breath, for the most glorious of all "victories. But, *on the other hand*, in case you are con-"quered, and the love of life should flatter you with the "hopes of being able to escape by flight, or you should "even consent upon any terms to live after your defeat; it "is manifest, beyond all doubt, that nothing but the ex-"tremity of wretchedness can await you: for surely "there is none among you, who, when you have "considered how vast a length of country you have "traversed, what enemies have opposed you in their way, "and what large and rapid rivers you were forced to pass, "could be so wholly destitute of all sense and judgment "as ever to be persuaded, that it was possible to regain "your several countries. I conjure you, therefore, to lay "aside all such hopes; and, in judging of your own state "and fortune, to retain those sentiments, which you have "just now shewn with regard to the condition of the cap-

" tives. As in that case you declared both the man that " conquered, and him who fell in the combat, *to be happy*, " and *pitied* those who were reserved alive; so your business now is, to conquer, if it be possible; and if not, to " die; and on no account to entertain even the smallest expectation or thought of life, in case your are conquered. " And if you will heartily embrace these sentiments, and " carry this resolution with you into action, there is indeed " no room to doubt, but that you must both live and conquer. For no troops were ever known to be defeated, " who had once been fixed in this determination, either by " necessity or choice. But that, *on the other hand*, an " army which, like the Romans, see their country open " to them on every side, and ready to receive all those " that can escape by flight, must necessarily fall beneath " the efforts of men, whose only hopes are placed in " victory."

When *we* feel ourselves hurried off by any uncommon effect, let us try to investigate the *cause*, and ask ourselves why we are thus delighted, thus affected? Effects indeed strike us, when we are not thinking about the *cause*; yet may we be assured, if we reflect, that a *cause* there is; and that too a *cause* intelligent and rational. In that part of the philippic of Demosthenes it is the *antithesis* that heightens the description; which is still more *forcibly* exhibited in the spectacle contrived by the Carthaginian general, and in his harangue.

On the *antithesis* often depends much of the beauty and clearness of history. We will take an example from Tacitus.

The night in *both camps* was busy and unquiet.

The Barbarians passed their time in jollity and carousing; warlike songs and savage howlings kept a constant uproar, while the woods and vallies rung with the hideous sound.

In the Roman camp the scene was different: pale gleaming fires were seen; no sound, save that of low and hollow murmurs; the soldiers lay extended at length under the palisades, or wandered from tent to tent, fatigued and weary, yet scarce awake. Cæcina was disturbed by a terrible dream: he thought he saw Quintillius Varus, who had been slaughtered with his whole army, emerging from the fens.

Arminius, at break of day, observing the baggage of the Roman army in their march stuck fast in a morass; the soldiers gathering round in tumult and disorder; the eagles in confusion; he ordered his men to make a vigorous attack; and by gashing and mangling the horses, made a dreadful havock.

Goaded by wounds, and not able to keep their legs on a slimy soil, which was made still more slippery by the effusion of their own blood, those animals in their fury overturned all in their way, and trampled under feet the wretches that lay on the ground. The chief distress was round the eagles; to support them under a heavy volley of darts was difficult, and to fix them in a swampy ground impossible. Cæcina, exerting himself with undaunted vigour to sustain the ranks, had his horse killed under him. The barbarians were ready to surround him, if the first legion had not come up to his assistance.

At length the rage for plunder, natural to savages, turned the fortune of the day. Intent on booty, the Germans desisted from the fight.

The Romans seized this opportunity, and towards the close of the day, they gained a station on solid ground. Their distress, however, was not at an end: entrenchments were to be raised; earth to be brought; their tools for digging and cutting the soil were lost; no tents for the soldiers; no medicine for the wounded; their provisions in a vile condition, deformed with filth and blood; a night big with horror hung over their heads; and the ensuing day, to a number of brave and gallant men, might prove the last.

Cæcina seeing this abased spirit of the legions addressed them from the part of the camp assigned for the eagles. Having commanded silence, he explained their situation, and the necessity that called upon them to act like men. "They had nothing to depend upon except their valour, "but their valour must be cool, deliberate, guided by "prudence. Let all remain within the lines, till the barbarians, in hopes of carrying the works, should advance "to the assault. Then will be the time to shew themselves. "If they fled, other woods, and deeper fens, remained behind; perhaps more savage enemies. By one glorious "victory they were sure of gaining every advantage; "honoured by their country, loved by their families, and "applauded by the whole army."

The Germans, in the mean time, were no less in agitation; their hopes of conquest, the love of plunder, and the jarring counsels of the chiefs, distracted every mind.

Arminius proposed "to let the Romans break up their "camp, and surround them again in the narrow defiles, "and in the bogs and marshes." Inguimer, more fierce and violent, and for that reason more acceptable to the genius of barbarians, "was for storming the camp: it "would be carried by a general assault; the number of "prisoners would be great, and the booty more entire." His advice prevailed.

At the point of day the march began: at the first onset the Germans levelled the fossè, threw heaps of hurdles, and attempted a scalade.

The ramparts were thinly manned; and the soldiers, who appeared to defend them, as if panic struck, fled.

The barbarians soon clambered over the works to pursue the flying enemy.

In that moment the signal was given to the cohorts; clarions and trumpets sounded through the camp; the Romans in a body, and with a general shout, rushed on to the attack. They furiously fell upon the enemy, crying aloud as they advanced, "Here are no woods, no treacherous fens; we are here on equal ground."

The barbarians had promised themselves an easy conquest. The affair they imagined would be with a handful of men; but their surprise rose *in proportion*, when they heard the clangour of trumpets, and saw the field glittering with opposing arms. The sudden terror *magnified* their danger. A dreadful slaughter immediately ensued. The two chiefs betook themselves to flight; Arminius unhurt, and Inguimer dangerously wounded.

No quarter was given. The pursuit continued as long as day-light and resentment lasted. Night coming on, the legions returned to their camp, covered with new wounds, and their provisions no better than the day before: but health, and food, and vigour, all things were found in *victory*.

SECTION LXI.

OPPOSITION OF LIGHT AND SHADE.

"*Let there be light*," said God, and forthwith light
Ethereal, first of things, quintessence pure,
Sprung from the deep, and from her native east
To journey through the airy gloom began,
Spher'd in a radiant cloud, for yet the sun
Was not: God saw the light was good;

And light from darkness by the hemisphere
Divided ; light the day, and darkness night
He nam'd. Thus was the first day ev'n and morn,
Nor past uncelebrated, nor unsung
By the celestial quires, when orient light
Exhaling first from darkness they beheld ;
——————With joy and shout,
The hollow universal orb they filled,
And touch'd their golden harps, and hymning prais'd
God and his works, Creator him they sung
Both when first ev'ning was, and when first morn.

Milton.

Painters, says Plutarch, increase the effect of the light and splendid parts of a picture by the neighbourhood of dark tints and shades; and Maximus Tyrius observes, that bright and vivid colours are always pleasant to the eye; but this pleasure is considerably heightened if you accompany them with tints somewhat dark and gloomy. These passages of the ancients seem to imply an acquaintance with the use of cold and dark tints, where a brilliancy of tone in other parts is required, although the discovery of the *claro-obscuro* is chiefly attributed to the moderns. One of the main excellencies of Raphael is his fondness for great masses of light, and deep shadows, which he observes equally in the naked as in the attired figure. The painters of the Venetian school more especially endeavoured by the opposition of coloured objects, and by the contrast of light and shade, to produce a vigorous effect, which demands and fixes the attention. This is more particularly the characteristic of the Dutch school. By their knowledge of contrast, they arrived at the difficult art of painting even light itself. Rembrant more especially delighted in the great opposition of light and shade. The room where he used to paint was darkened, and he received the light only by a small aperture in the shutter, which he contrived so as to fall and illumine the object he was designing. Hence Rembrant's manner of painting appears like magic. None exceeded him in the knowledge he had of the effects of different colours mingled together, nor could better distinguish those which did not agree with those which did. He placed every tone in its place with so much exactness and taste, that he needed not to mix his opposing colours, and so destroy what may be called the flower and freshness of them. He often loaded his lights with so great a quantity of colour (to make the brightest reflection), that in some instances he may be said to model and not to paint. In his famous picture representing the *virgin* at the foot of the cross on Mount Calvary, the principal light darts upon her through a break of the clouds, while all the other figures stand obscured by shade. In the resurrection of Lazarus there is introduced a long stream of light on the principal objects. It is by this means that his compositions appear so strikingly divided into different groups. Tintoret, too, acquired great reputation, as well as briskness, with which he enlivened his figures, by his masterly manner of placing his lights and shadows. Tintoret, as well as Poussin, modelled their figures, and used to illumine them by a bright lamp or candle light, by which means they were able greatly to heighten their lights and shadows. Among painters of our day none have carried this opposition to higher perfection than Mr. Russel, in his picture of Cupid presenting the night-blowing Cereus to Hymen*. The torch and altar of Hymen reflect warm light on the figures, whilst the back-ground scenery has the cold and blue light of the moon partly obscured by clouds. This is also very finely exhibited in some sublime paintings by Pether. He has represented an irruption of

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* This picture was painted for Dr. THORNTON'S *New Illustration of the Sexual System of* LINNÆUS.

Mount Vesuvius during a full moon, each mingling their different lights upon the heaven and on the waters. In another picture we have a village on fire with a moon-light scenery; and in a third, a moon-light with the warm emanation from a forge of a blacksmith's shop. That these paintings owe much of their effect from the principle we are endeavouring to prove by a variety of arguments, we think no one can deny, and the principle itself is generally known and allowed by painters themselves.

SECTION LXII.

OPPOSITION OF CHARACTER.

Opposition of character is the soul of historical painting, of poetry, and of the drama. From the school of Athens by Raphael we shall select one out of the many excellent groups with which it abounds, to illustrate this observation. Four boys are attending on a mathematician, who, stooping to the ground with his compasses in his hand, is giving them the demonstration of a thorem. One of the boys, recollecting within himself, keeps back, and his eyes are drawn off from his master in the profoundest revery; another, by the briskness of his attitude and immediate attention, discovers a greater *quickness of apprehension*; while a third, who has already seized the conclusion, is endeavouring to turn master, and to drive it into a fourth, who stands motionless, with a staring countenance, and has so much marked *stupidity* in his looks, as to shew he will never be able to understand any thing about it.

Poussin, in his famous picture of a sleeping Venus, has introduced a Satyr, which is intended to heighten the effect of contrast.

SECTION LXIII.

DISCORD.

'Twas when the seas were roaring
With hollow blasts of wind;
A damsel lay deploring,
All on a rock reclin'd.

Wide o'er the foaming billows
She cast a wistful look;
Her head was crown'd with willows
That trembled o'er the brook.

" Twelve months are gone and over,
" And nine long tedious days:
" Why didst thou, vent'rous lover,
" Why didst thou trust the seas?

" Cease, cease, thou cruel ocean,
" And let my lover rest:
" Ah! what's thy troubled motion
" To that within my breast!

" The merchant, robb'd of pleasure,
" Views tempests in despair;
" But what's the loss of treasure
" To losing of my dear!

" Should you some coast be laid on,
" Where gold and di'monds grow,
" You'd find a richer maiden,
" But none that loves you so.

" How can they say that Nature
" Has nothing made in vain;
" Why then beneath the water
" Do hideous rocks remain?

"No eyes these rocks discover,
"That lurk beneath the deep,
"To watch the wand'ring lover,
"And leave the maid to weep."

All melancholy lying,
Thus wail'd she for her dear;
Repaid each blast with sighing,
Each billow with a tear.

When o'er the white wave stooping,
His floating corpse she spied;
Then, like a lily, drooping,
She bow'd her head, and died.

The very strong emotions that this song excites, arises not only from the sweet harmony and simplicity of the verse, and delicacy of the sentiment, but also from the art of the composer of the music in contrasting the parts: the first being in three sharps, and the following recitative in a minor key, full of the finest melody, with several contrasting notes of discord. The very powerful effect of the Allegro and Il Penseroso of Milton depends upon contrast, and some sublime passages in Handel's Messiah arises from discords, as also from some sudden bursts of harmony in the chorus, preceded by a single voice.

SECTION LXIV.

THE DISCOVERY.

Edgar. List a brief tale,
And when 'tis told, O, that my heart would burst!
The bloody proclamation to escape,
That follow'd me so near; O, our lives sweetness!
That we the pain of death would hourly bear
Rather than die at once, taught me to shift

Into a madman's rags; t' assume a semblance,
The very dogs disdain'd; and in this habit
Met I my father, with his bleeding rings,
Their precious gems new lost; became his guide,
Led him, begg'd for him, sav'd him from despair:
—Never, O fault, reveal'd myself unto him,
Until some half hour past, when I was arm'd,
Not sure, tho' hoping of this good success,
I ask'd his blessing, and from first to last
Told him my pilgrimage. But his *flaw'd heart,*
Alack, too weak the conflict to support,
'Twixt two extremes of passion, JOY and GRIEF,
Burst smilingly.

SECTION LXV.

ABSENCE FROM HOME.

The celebrated traveller Cox observes, "one great advantage he derived from his journies, which was, that "he was led by them to prefer his own to every other "country." Whether this arose from the power of reflection we will not presume to say, for every one has experienced the pleasure of returning *home*, when he has been out but a few weeks *even on a party of pleasure.*

For where to find that happiest spot below,
Who can direct, when all pretend to know?
The shudd'ring tenant of the frigid zone
Boldly proclaims that happiest spot his own;
Extols the treasures of his stormy seas,
And his long nights of revelry and ease:
The naked negro, panting at the line,
Boasts of his golden sands and palmy wine;
Basks in the glare, or stems the tepid wave,
And thanks his gods for all the good they gave.

That the passion for one's country is increased by *absence*, is particularly manifested by the natives of Switzerland. They were so affected by a little air, expressive of their situation, that it is affirmed by several, that it once excited so exquisite a solicitude, that it was therefore prohibited to be played in France upon pain of death.

THE AIR.

Quand reverrai'je en un jour
Tous les objets de mon amour:
Nos claire ruisseaux
Nos coteaux,
Nos hameaux,
Nos montaignes?
Et l'ornement des nos compaignes?
La si gentil le sabeau
A l'ombre d'un ormeau,
Quand danserai'je au son du chameau?
Quand reverrai'je en un jour,
Tous les objets de mon amour?
Mon pere,
Ma mere,
Mon frere,
Ma sœur,
Mes agneaux,
Mes troupeaux,
Ma bergere,
Quand reverrai'je en un jour,
Tous les objets de mon amour.

In this air the images are all rural and simple, and in the highest degree affecting. The music is also remarkable for its simplicity, and sudden transition of measure, varying frequently from allegro to andante. When this little air was played or sung to the Swiss soldiers, they would express sighs and tears, and would not unfrequently desert in the impulse of the moment; and such as shewed silent dejection, and scorned so base a procedure, fell martyrs to their own feelings, by a disease called *Nostalgia* *.

Xenophon, in his retreat of the ten thousand, gives a very lively description of the tumultuous joy which the army exhibited, when they first saw the sea from Mount Theches, where they instantaneously erected a trophy amidst the loudest acclamations. The strong emotions of the followers of Columbus upon seeing land, may be explained also upon this principle.

SECTION LXVI.

DISAPPOINTMENT.

His late Majesty George II. having kept the audience waiting, much confusion arose in the theatre, and a hiss even reached the ear of Majesty upon his arrival. The King, with admirable presence of mind, took out his watch, and looking at it, appeared to say something to a lord in waiting, and, placing his hand to his breast, bowed to the audience. This confession, from so high a personage, instantly overwhelmed the hearts of the whole assembly, and without exception the whole house joined in reiterated plaudits, and it was a long while before the effusion ceased, and the play could be proceeded with.

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* A vehement longing after home.

SECTION LXVII.

LOSS.

——— It so falls out,
That what we prize not to the worth,
While we enjoy it; but being lack'd and lost,
Why then we *rack the value;* then we find
The virtue that possession would not
Shew us whilst it was ours.
SHAKSPEARE.

SECTION LXVIII.

HUNTING, WAR, AND GAMING.

Cards were at first for benefits design'd;
Sent to amuse, and not enslave, the mind:
But from such wise end they must soon depart
From this principle of the human heart,
Which not in pleasure's self can pleasure find,
Unless it comes with *agitation* join'd;
Which, basking warm in fortune's sunshine clear,
Sighs for the shifting clouds of *hope* and *fear;*
And tir'd with looking on the listless deep,
When lull'd by summer gales to silver sleep,
Would rather far the tempest's fury brave,
When danger rides on ev'ry foaming wave.
WHIST, A POEM.

If we contemplate a savage nation in any part of the globe, supine indolence, and sometimes violent exertions, will be found to constitute their general character. In a civilized state, every faculty of man is expanded and exercised; and the great chain of mutual dependance connects and embraces the several members of society. The most numerous portion of it is employed in constant and useful labour. The select few placed by fortune above that necessity, can, however, fill up their time by the pursuit of ambition, by the improvement of their estate, by the duties, the pleasures, and even the innocent follies of social life. These, by reading and reflection, multiply their own experience, and live in distant ages and remote countries; whilst the former, rooted to a single spot, and confined to a few years of existence, surpasses but very little his fellow-labourer the ox, in the exercise of his mental faculties.

> Their level life is but a mould'ring fire,
> ———————— or if raptures cheer
> On some high festival of once a year,
> In wild excess the vulgar breast takes fire,
> Till, buried in debauch, the bliss expire.

The lazy savage, destitute of every art that can last out the day, if his hunting has procured enough, passes his time in the animal gratifications of eating and sleep. And yet, "by a wonderful diversity of nature," which could not fail to escape the observation of Tacitus, who has applied the *science of philosophy* to the *study of facts*, "The same barbarians are by turns the most indolent and the most restless of mankind. They delight in sloth, they detest tranquillity. The languid soul, oppressed with its own weight, anxiously required some new and powerful sensation; and *war* * and *gaming* were the only gratifications most suited to this temper of mind.

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* The passion for war, in the savage breast, is strongly exemplified in the following history. When Constantinople was taken by the Turks, Irene, a young Greek of an illustrious family, fell into the hands of Mahomet II. who was at that time in the prime of youth and glory. His savage heart being subdued by her charms, he shut himself up with her,

" The sound that summoned the German to arms was grateful to his ear. It roused him from his uncomfortable lethargy, gave him an active pursuit, and, by strong exercise of the body, and violent emotions of the mind, restored him to a more lively sense of his existence.

" In the dull intervals of peace, the Germans were immoderately addicted to deep gaming, and excessive drinking; both of which by different means, the one by inflaming the passions, the other by extinguishing his reason, alike relieved him from the pain of the want of employment.— They gloried in passing whole days and nights in this tumult of the passions, and the blood of friends and relations often stained their numerous assemblies. The desperate gamester, who had staked his person and liberty on the throw of the die, such was the point of honour among these barbarians, or rather depraved obstinacy, as Tacitus

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denying access even to his ministers. Love obtained such an ascendancy as to make him frequently leave the army to stop with his Irene. War relaxed, for victory was no longer the monarch's favourite passion. The soldiers, accustomed to booty, began to murmur, and the infection spread even among the commanders. The Basha Mustapha, consulting the fidelity he owed his master, was the first who durst acquaint him of the discourses held publicly to the prejudice of his glory. The sultan, after a gloomy silence, formed his resolution. He ordered Mustapha to assemble the troops the next morning ; and then with precipitation retired to Irene's apartment. Never before did that princess appear so charming; never before did the prince bestow so many caresses. To give a new lustre to her extraordinary beauty, he exhorted her women to bestow their utmost art and care on her dress. He that morning took her by the hand, and led her into the midst of the army, and, pulling off her veil, demanded of the bashas, with a fierce look, whether they had ever beheld such a beauty ?— After an awful pause, Mahomet, with one hand laying hold of the young Greek by her beautiful locks, and with the other pulling out his scymitar, severed her head from the body at one stroke. Then turning to his grandees, with eyes furious and wild,—*This sword,* says he, *when it is my will, knows how even to cut the bands of love.*

more justly styles it (ea est in re prava pervicacia, *ipsi* fidem vocant), that they patiently submitted to the decision of fortune, and suffered themselves to be bound hand and feet, and sold into remote and cruel slavery by his weaker and more lucky antagonist."

SECTION LXIX.

LICENTIOUSNESS.

Colonel Gardiner, a gentleman of fortune, who, to all the advantages of a liberal and religious education, added every accomplishment that could render him most agreeable, early entered into the army, and was soon called into actual service, at which time he behaved with a gallantry and courage, which will always give a splendour to his name among the British soldiery, and render him, in this respect, an example worthy of their imitation. But, alas! amidst all the intrepidity of the martial hero, you see him vanquished by the blandishments of pleasure, and plunging into the most criminal excesses. Before he had attained the age of twenty-two, he fought three duels. In the battle of Ramillies, he was shot through the neck, and by a singular intervention, as it were, of Providence, when the strippers of the dead came to him, and had taken up an instrument wholly to abolish life, being faint and speechless from loss of blood, a friar interfered, and some spirits being given him, he was revived, and made prisoner. He still, however, lived without a sense of God or religion. After his exchange he rose gradually in the army, till at last he became aid-de-camp to Lord Stair. He then went to Paris, during the regency of the Duke of Orleans, and lived in a court the most dissolute in the world. What, by a wretched abuse of words, is styled gallantry, was the whole business of his life, and his fine constitution, fascinating person, and elegant address, gave him full opportunity of indulging in every excess, so that he generally went by the name of the *happy* Englishman. When returning to England, as he was going post upon a French horse, the animal fell with him, and he was picked up for dead. When, in the packet boat, a few weeks after, a violent storm arose, and the vessel was driven on the coast of Holland, and the ship was in so much danger, that the captain urged all in turn to prayers. It was then that Colonel Gardiner first seriously considered the follies and the crimes he had been guilty of; that he was not sent into this world for nought; that he had neglected the part assigned to him; had degraded his own nature; and, instead of being useful, had been hurtful and pernicious among those with whom he had acquaintance. What account was he to give to his Maker? Self-condemned, polluted by so many crimes, how was he to find mercy in the sight of God? Hence, an overwhelmed and dejected mind; hence dismal forebodings of punishment; hence that wounded spirit, which who can bear? His prayer was long and fervent, and troubled with many tears. The mercy of God was again shewn him, but among his giddy and dissolute companions he soon after endeavoured to excuse himself the scandal of "*having prayed.*" In July 1719, having made an assignation with a married lady, a woman of rank, on a sabbath evening, to kill time he went to a neighbour's house, and the master being suddenly called out, he stumbled upon a book, whether placed there by accident or design I do not remember, which was called the *Christian Soldier:* as the hour was not yet arrived, he took up this book, and from the title he had curiosity to dip into it. Some passages struck his attention, and he read on until he fell asleep. He dreamt he saw an unusual blaze of light poured upon the book, and he afterwards had a strong visual representation of the LORD JESUS CHRIST upon the cross, surrounded on all sides with glory, who addressed him, "as an ungrateful sinner, despising the "numerous mercies shewn him." When he awoke, the impression was so vivid, that he could scarce conceive it had been a dream; he then looked back with horror on his past life; he would fain have kneeled down and asked pardon of GOD, but he thought he was a monster as yet too vile to supplicate; he never once remembered the assignation, but went home, and passed this and the three succeeding nights, without the refreshment of sleep, in fasting and in prayer. His mind was continually taken up in reflecting on divine purity and goodness; the grace, which had been proposed to him in the gospel, which he had rejected; the singular advantages he had enjoyed and abused; the many mercies he had received and despised; with the vain folly of that career of pleasure, which he had been so many years running after with desperate eagerness, all rousedhis indignation against the great "Deceiver," by whom, to use his own expression, "he had been so "wretchedly befooled." Thus the whole frame and disposition of his soul was new modelled and changed; and he became, and continued to the very last, a most pious and exemplary Christian.

In the year 1140, that is to say, a little more than six hundred years ago, a Count of Perch, who had led a very irreligious life, made a vow, during a violent tempest, that if he escaped shipwreck, he would found, upon his estate, a monastery, and that the roof of the church should have the form of a ship's keel. Upon his return to his domain, he chose, for the situation, a wild valley, very low, and the only descent was by a narrow passage, hence the name La Trappe. The regulations of this convent were exceedingly austere. By degrees its manners became relaxed, when a singular adventure gave rise to the greatest reform in this institution. The estate fell by inheritance to M. L'Abbe de Rancé, a man of a good family, and naturally of a benevolent heart, but given up to an unfortunate amour. As he returned from a journey, having been absent but for a few days upon business, on his arrival he went to his beloved mistress, a woman of the greatest beauty and vivacity, and by means of a key he passed along the dark passage, and ascending by a private staircase, opened the door of her chamber, when lo! instead of the beauteous Monbazon, he beheld, by means of a blue lamp, a head besmeared with blood on the toilette, and casting his frantic eyes around, he saw a coffin in which she was placed, which, being too small, the head had been cut off, and put in a dish upon the table. This frightful spectacle inspired him with the resolution of abandoning the world, and of entering into the convent of La Trappe, where he introduced all the austerities of St. Barnard.

Now did REMORSE efface the guilty scene,
Which to his breast apply'd her dagger keen,
Restrain'd in full career the erring youth,
And led him back to innocence and truth;
'Twas *here* he fled, divorc'd from pleasure's chain,
To woo religion in this gloomy fane,
To wash away with tears his errors past,
And spend each day, as though it were his last.

The monks of La Trappe never speak, they eat only vegetables, and drink water; they rise every morning at two, and after matins they make themselves a grave, in remembrance of their mortal state; they wear camlet next the skin, and lie upon straw. In the place where they assemble to warm themselves, which is the only indulgence they take, over the fire-place, there is the picture of a most beautiful woman, and a person turns it every five minutes, when a half putrified skeleton appears.

SECTION LXX.

A DISPUTE.

When doctors disagree, who can decide?

Girtanner, and Brown, say the passions differ from each other only in stimulating the irritable fibre more or less. Anger and joy are very powerful degrees of the nervous stimulus; content and hope are lower degrees; fear, despair, and sorrow, are not absolute degrees of this stimulus, they are only the abstraction of the stimuli of hope, content, and happiness. Anger and joy act as very powerful stimuli, and exhaust the irritability of the fibre in the same manner as any other stimulus whatever. Content and hope are degrees of the nervous stimulus necessary to preserve the tone of the fibre. Sorrow and despair are degrees too weak.

In a discourse on taste, written by Dr. Usher, we find nearly the same sentiment. The system I mean to propose, says this elegant writer, is that of a friend of mine, who was a true lover of knowledge. He found little satisfaction in the philosophy of colleges and schools, particularly in those enquiries he thought of most importance: he had withdrawn himself from the trifling bustle of the little world, to converse with his own heart, and end a stormy life in obscure quiet. One day, after dinner, we walked out to indulge on our favourite topic. Our excursion terminated at a rock, whose base is washed by the western ocean. It was one of those fine days in August, when the cool of the evening brought on a refreshing sweetness. We sat down to rest and enjoy the prospect of the sea, that stretched before us beyond the limits of the eye. The sun was just setting, and his last softened beams flying to the shore, seemed to dip in a thousand waves, and leave in the waters the blaze they lost. Being seated, our conversation turned on the *sublime.* It is easy, says this thoughtful philosopher, to describe the impressions the sublime make on the mind, and this is all the writers on this subject have hitherto done ; but is it impossible, from a due attention to the symptoms, to unravel its meaning, and discover the *spring* of the silent astonishment it impresses on the spirit of man? In order to proceed to the discovery we desire to make, let us turn our views to objects remarkably sublime, and from them obtain what intelligence we can. Observe this mountain that rises so high on the left, if we had been further removed from it, you might see behind it other mountains rising in strange confusion, the furthest off almost lost in the distance, yet great in the obscurity; your imagination labours to travel over them, and the inhabitants seem to reside in a superior world.— But here you have a different prospect, the next mountain covers all the rest from your view; and, by its near approach, presents distinctly to your eye objects of new admiration. The rocks on this side meet the clouds in vast irregularity ; the pensive eye traces the rugged precipice down to the bottom, and surveys there the mighty ruins that time has mouldered and tumbled below. It is easy, in this instance, to discover that we are terrified and silenced into awe, at the marks we see of immense power; and the more manifest are the appearances of disorder, and the neglect of contrivance, the more plainly we feel the boundless might these rude monuments are owing to. The same sensation arises when we behold an ocean disturbed and agitated in storms; or a forest roaring, and bending under the tempest. We are struck by it with more calmness, but equal grandeur, in the starry heavens: the silence, the unmeasured distance, and the unknown power united in that prospect, render it very awful in the deepest serenity. Thunder, with broken bursts of lightning through black clouds; the view of a cataract, whose billows fling themselves down with eternal rage; or the unceasing sound of the falling waters of night; all these produce the effect of the sublime, and are associated with the sensation of immense power. This religious passion has none of the tumult of other passions, its object is incomprehensible, it is unknown; therefore the passion is in itself obscure, and wants a name. Curiosity and hope carry with them the plainest symptoms of a passion that wanders and is astray from its object. In their anxious search, they unite themselves with every great prospect of life, whose completion lies in the dark: but when we arrive at the point we proposed, we are fully sensible that curiosity and hope have been deceived, the enjoyment of our power, whatever it be, falls infinitely below our expectations, yet the alacrity of the mind feels no decay by disappointment; we set out immediately with renewed vigour in pursuit of something further, and nothing but death puts an end to these active energies of the soul. Such passions as these are scared away by the majesty of darkness and of silence, by the disorder and confusion of seas in storms, or when lofty woods struggle with high winds, and we are struck with humiliating awe and suspense. We secretly cry, "What is "man that thou art mindful of him, and the son of man "that thou shouldest regard him." I appeal to the feelings of every person, if his passion, under these circumstances, be not exactly applicable to this state of the mind, when confidence almost vanishes, and despair succeeds. All mankind agree, that darkness, solitude, and silence, naturally oppress the mind by a tremendous and sublime sensation. It is further evident, *that they produce not* (continues Dr. Usher) *this effect* BY ANY ACTIVE POWER OF THEIR'S, *but merely by stripping the imagination of its sensible ideas, of the noise, the mirth, and light, that diverted its attention, leaving it to its naked state and feeling.*— In short, it appears, from a great variety of observations and reflected lights, that the human soul is always *oppressed* by obscurity and stillness, which prevents the mind from being employed on exterior objects. To avoid *this sensation* it is that we seek amusement and company, and that any diversion, however insipid and trifling in itself, becomes to us a pleasing relief, merely by taking up our attention. Reason may smile at the puerility of our amusements. The votaries to the pomps and vanities of the world acknowledge they will not bear examination: yet the wise and the vain find solitude alike insupportable, and alike desire the company and the pageantry they despise. Men easily bear imprisonment, poverty, sickness, and even great degrees of pain; but the obscure despair, whose object is not known, is blacker than the grave, and more terrible than death, and to plunge from it men commit suicide. Every calamity of this life is supportable, and we suffer them by choice rather than death, until they bring us to a pensive solitary state of mind, in which we feel the *pressure* of an unknown power; and then men often make the cruel choice, and seek death as a welcome release from that *insupportable ennui* which thus overpowers them.

The illustrious Dr. Beddoes, on the other hand, opposes the doctrine, " *that the depressing passions, as they have* " *been called, are only the abstraction of the ordinary ex-* " *citing passions.*"—Universal experience, I apprehend, says he, will reject such a scale of mental affections, as this system supposes. Who can believe, says this philosopher, that in sorrow the mind is *less active* than in joy.

K. Phil. Patience, good lady! comfort, gentle Constance!

Const. No, I defy all counsel, all redress,
But that which ends all counsel, all redress,
DEATH, DEATH: come grin on me,
And I will think thou smil'st,
And buss thee as thy wife!

K. Phil. Oh fair affliction, peace.

Const. No, no, I will not, having breath to cry;
Oh, that my tongue were in the thunder's mouth!
Then with a passion would I shake the world;
And rouse from sleep that fell anatomy,
Which cannot hear a lady's feeble voice.

Pand. Lady, you utter *madness*, and *not sorrow*.

Const. I am not mad, this hair I tear is mine,
My name is Constance, I am Jeffery's wife;
Young Arthur is my son, and he is lost!
I am not mad, I would to heav'n I were!
For then 'tis like I should forget myself.
Oh, if I could, what grief should I forget!

I am not mad; too well, to well I feel,
The diff'rent plague of each calamity.
If I were mad, I should forget my son.

K. Phil. You are as fond of grief as of your child.

Const. Grief fills up the room of my absent child,
Lies in his bed, walks up and down with me;
Puts on his pretty looks, repeats his words,
Remembers me of all his gracious parts;
Stuffs out his vacant garments with his form,
That I have reason to be fond of grief.
There was not such a gracious creature born!
But now will *canker* SORROW *eat my bud,*
And chace the native beauty from his cheek,
And he will look as hollow as a ghost;
As dim and meagre as an ague fit;
And so he'll die;—and rising so again,
When I shall meet him in the court of heav'n,
I shall not know him; therefore, never, never,
Must I behold my pretty Arthur more!

The followers of Dr. John Brown must indeed acknowledge that grief, accumulated grief, is sometimes an active passion, by raising continued images to the mind, and may destroy by excess of one continued unchangeable excitement, but grief, they observe, in general soon sinks into *despondency*.—Lewes, upon hearing the death of Arthur, says,

There's now nothing in this world can make me joy
LIFE is as *tedious* as a *twice told tale,*
Vexing the *dull ear* of a *drowsy man*

SECTION LXXI.

EXAMPLE OF THE SEDATIVE EFFECTS OF SILENT GRIEF.

Mademoiselle de Launay, afterwards Madame de Staal, and many other persons of the household of the Duke and Duchess of Maine*, were arrested and sent to the Bastile on the 29th of December. The Duke of Maine was seized at his house at Seaux, and sent to the castle at Dourlens at the Hotel de Thoulouse in Paris, and then to Dijon.

" They put me," says Madame de Staal, " into a coach " about seven in the evening, with three musketeers. I

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* The regent had some time before been informed of a secret correspondence of the Duke and Duchess of Maine with the court of Madrid, through the means of the Spanish ambassador, the Prince of Cellamare. He got intelligence, that some dispatches of great importance had been sent away by the Abbé de Porto Carero, and concealed in a double bottom that had been made to his chaise for that purpose. It is said, that he first received this information from a woman that kept a house of pleasure, who, like many others of the same profession, was personally known to the regent, and was now employed by him as a spy. The ambassador's secretary one day excused himself for not keeping an appointment at her house, by saying, that he had been engaged with dispatches that were but just sent off by the Abbé Porto Carero. Notice of this was immediately given to the regent: on inquiry the circumstance was confirmed; orders were sent to arrest and examine the abbé; he was stopped at Poitiers; the dispatches were taken from him, and he was permitted to proceed on his journey. After reading them, the regent ordered the ambassador's house to be surrounded with guards, and searched. This intrigue had been chiefly managed by the Duchess of Maine. It appears, that her views principally went to dissuade the court of Spain from acceding to the quadruple alliance, to engage it to use its influence to obtain an assembly of the States in France, and to get the assembly to enforce the will of Louis XIV. and the dispositions that had been made by him in favour of his legitimated natural children.

" imagined the journey would not be long, and that they " were carrying me to the Bastile. We accordingly arrived " there. They made me get out at a small bridge, where " the governor received me. As soon as I entered, they " pushed me behind a door, as some of our party arrived " at the same time, by whom they did not choose I should " be seen.—Those being put into their cages, the governor " conducted me to mine.

" My room had only the bare walls bedaubed with char- " coal, the pastime of my predecessors. They brought a " straw-bottomed chair; two stones to support a faggot with " which they made a fire; they very ingeniously stuck a " tallow-candle against the wall; these conveniences being " procured, the governor left me, and I heard five or six " monstrous bolts locked behind him.

" At last the governor made his appearance again, bring- " ing Mademoisselle Rondel* with him. She asked him " in a very deliberate manner, if we were to lie upon the " floor. He answered with a sort of merriment, which we " thought out of season, and left us.

" While we were thus in conversation, our doors opened " with great noise. Indeed this cannot be done otherwise. " They † desired us to go into another room, but without " saying why. They don't give reasons there, and every " one you see, has something in his face that tells you not " to ask any questions.

" The night was far advanced, and we neither saw beds " nor supper; but shortly afterwards, they came and took " us back to our former room. I now found here a small " bed, neat enough; an arm chair, two other chairs, a " table, a bason, an earthen pot with water, and a kind " of truckle-bed for Rondel. She did not like her bed,

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* Her maid, and companion in her prison.

† The turnkeys, who had come in.

" and complained; but she was answered, that they were " his Majesty's beds, and that she ought to be content. " No reply could be made to this:—they went away, and " shut us up as before.

" To procure the most simple necessary that we are " apprehensive of being deprived of, affords more joy than " the greatest piece of luxury to those who are in want of " nothing. I was exceedingly pleased to see my bed; I " began to wish for supper, and recollected the musketeer, " who had advised me to eat some dinner. It was now " eleven. The supper at last came, but very late: the " great business of the day had occasioned some derangement, and was not a little surprised to see served the day " following at six o'clock, what to-night I had so long " waited for. I supped, I lay down, and fatigue and oppression would probably have made me sleep, had I not " been prevented by a bell that the sentinel struck every " quarter of an hour, to shew that he was awake.

" Monsieur de Launay, the governor of our castle, had " taken possession of his office but the day we arrived " there. His predecessor, Monsieur de Bernaville, died " the day before. De Launay was his relation and pupil, " and he had perfectly fashioned him to all the practices " of the jail. He came to see me the next morning; and " as he affected an air of pleasantry, I did the same. He " already found me perfectly tamed. I asked him for some " books and cards. He sent me some odd volumes of " Cleopatra, which I made the most of, and played at " piquet with Rondel.

" We shall have a fine opportunity, says Rondel, on " Sunday, at the chapel, to see the other prisoners of the " castle. But she was mistaken. I was concealed in a " niche where I neither could see nor be seen.

" Being entirely occupied with other thoughts, I had

“ paid so little attention to what I brought with me, that I “ was soon in want of every thing. I had no other cornet, “ but the one on my head; nor any more shifts than a “ heroine of romance, who has been suddenly run away “ with. My only resource was in the industry of Rondel, “ who washed my linen in the bason in which we washed “ our hands. While she was washing the cornet, I put “ on my head the only handkerchief I had left, and it was “ in this extreme dishabille I received the first visit of the “ Lieutenant du Roi. No situation can prevent a woman's “ being displeased, at appearing to disadvantage before one “ she sees for the first time.

“ Mons. de Maison-rouge, who had lately got this place, “ had been a Major of cavalry, and never had seen any “ thing but his regiment. He was an honest open soldier, “ full of excellent qualities, which were by no means disgraced by a certain rusticity and bluntness, that seemed “ naturally allied with them.” He endeavoured to comfort her, but,” she proceeds, “ this sort of conversation “ appeared to me extremely suspicious;—I thought he “ wanted to ensnare me;—I did not know him then.

“ When my wants were at the utmost, the governor “ came into my room one day with a purse of gold, and “ followed by a man carrying a large bundle of my clothes. “ I should not have known from whence they came, if I “ had not recollected the purse which I had worked and “ given to Monsieur de Valincourt. He was not afraid to “ avow his solicitude for me, at a time when my other “ friends would not acknowledge my acquaintance.

“ I should now have found some repose, had it not been “ for an idea that unfortunately got possession of my mind, “ and almost constantly disturbed it. Some days before “ I was arrested, happening to speak of the Bastile to the “ Abbè Chaulieu, he told me a story of a woman of rank,

" who, to make her declare her secrets, had been privately
" put to the torture. As I was thought to be in the confidence of the Duchess of Maine, I imagined, that if they
" had recourse to that expedient with any one, it would be
" with me. I had a wonderful desire to examine this matter, but I knew not how to go about it. One day that
" our Lieutenant du Roi came to see me, I ventured to
" bring the discourse upon things I had been told about
" the Bastile; but he treated them as childish stories. At
" last lowering my voice, as people generally do when they
" are embarrassed and afraid, I said, it was even pretended
" that persons had been put to the torture without any
" form of trial. He made no reply. We were walking up
" and down the room; he took another turn, and went away
" I thought, a little too abruptly. I remained confounded;
" and almost persuaded that I was destined to undergo
" this horrid ceremony. I imagined he knew it—I continued walking with immensely long steps, and making
" profound reflections. I found out afterwards that the
" lieutenant was deaf of one ear, and that I had got on his
" deaf side when I addressed my last observation to him.
" I have often laughed since at the fright his supposed circumspection then occasioned me."

The governor asked her, if she wished to confess; she desired it exceedingly, but wanted a confessor of her own choosing. He told her that was impossible, and she must be satisfied with the confessor belonging to the castle. To a mind already tainted with distrust, this was enough to rouse it. She imagined the confession might be made use of to obtain her secrets. She was for some time perplexed between her duty and her fears; her devotion, however, prevailed, and she says, " Never was any suspicion more
" unjust; I found him (the confessor) full of goodness,

"simple, and compassionate; more disposed to pity me "for my misfortunes, than reprove me for my faults."

The following passage shews the extreme precaution that was observed at the Bastile, to prevent the prisoners from having any communication with persons abroad.

"Throwing myself on my knees before the governor, I "entreated him to write with his own hand a note that I "should dictate, to Madame de Grieu, merely to relieve "her from the terrible state of anxiety in which I knew she "must be on my account; but he was inexorable, fearing "the plainest expressions, though written by himself might "convey an hidden meaning."

The Lieutenant du Roi, the honest Maison-rouge, became the captive of his prisoner. "Though he did not explain "himself clearly, all his actions proved it. An attention "to all my wants, that never diminished; a complacency, "without affectation; a greater desire to see me satisfied, "than to please me; and a mind so much devoted to me, "that he seemed to forget his own existence. I have never "been a witness in real life, or read in romance of sentiments so pure: sentiments that were invariable; and so "much the more valuable, as they were not the effect of "reasoning and refinement, but of simple nature; who "seems to have taken pleasure in making a heart, of "which she could say, *Here at least is one, in which there* "*is nothing to be found fault with.*"

Near her apartment was that of the Chevalier de Menil. They never had seen each other; but the similarity of their situations, and their common danger, made her take an interest in what concerned him. Maison-rouge, who was constantly thinking of ways to amuse her, proposed to Menil to write her some verses. The verses were answered; they were followed by letters; the letters by visits; and those produced a mutual passion, that had been already been prepared by sympathy. It was declared by the one, and soon avowed by the other. She says, " Le " pays que nous habitions abrêge beaucoup de formali- " tés. Par-tout ailleurs j'eusse été long temps sans vouloir " ecouter ; plus long temps encore à repondre ; mais dans " un lieu, ou, parvenus a se voir on ne scait pas si l'on se " reverra jamais, on dit en un heure ce que, hors de là, " on n'eut pas dit, peut-etre, dans un année : et non seul- " ment on y parle, mais on y pense tout autrement qu'on " ne feroit ailleurs*."

One day that the Lieutenant du Roi was abroad, the governor met the Chevalier de Menil returning from the apartment of Mademoiselle de Launay to his own. The offence was punished, by his being removed to another tower, and confined with greater rigour. In her distress she resolved to avow to Maison-rouge her passion for Menil; to entreat his good offices for him and to get him to facilitate their correspondence. She says, " He remained for " some time as if lost in a confusion of sentiments ; but the " effects of my affliction, and of the confidence I had placed " in him, began to shew themselves on his countenance. " At last, making an effort to explain himself, he said : " You know how much I am devoted to you ; I will now " give you a proof of it, but you must explain the nature " of your connection with Monsieur de Menil. If his " intentions are pure, if he means to make you honourably " happy, I will give myself up without reserve to every " thing that can contribute to *your* welfare : but unless his " conduct be unquestionable, it would be unworthy of you

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* " Every where else I should have been a long time without listening to, " yet longer in answering, such declarations ; but in a place where we " might never meet each other again, one says in an hour, what other- " wise, perhaps, one had not said in a year : and not only speak, but think " different from what we should do elsewhere."

" to have any farther communication with him, and it " would be disgraceful to me to have been employed in it." Having satisfied him, that nothing had ever passed between them with which virtue or modesty could be offended, and that they were pledged to each other in marriage, they, through his means, daily wrote to each other; but, says she, " he has avowed to me since that, every letter we " delivered to him was *a poignard plunged into his bosom*; " yet he was not the less exact in faithfully observing the " rules he had established for our correspondence."

By an order from the regent, the Chevalier de Menil was allowed a greater degree of liberty; he now dined frequently with the governor, and spent much of his time with the duke of Richlieu, who was then likewise in the Bastile.

The Duke and Duchess of Maine having been permitted to return to Seaux, the prisoners in general, who had been arrested on their account, were treated with less severity than before. They were allowed to visit each other, and they generally met in the evenings at the apartments of a Madame de Pompadour. Madame de Staal, at this period of her imprisonment, says, " My connection with Menil, " however painful to Maison-rouge, had been softened by " the opportunity he had of being useful to me. He con- " ducted our correspondence; and, as he knew all we did, " it set limits to his anxiety: but, by this change, even that " sort of consolation was taken away, and there only " remained gratitude for services we no longer stood in " need of." He said, " You are now happy; I wished it. " Live in peace with one you love, but do not exact from " me, that I should witness it. As long as my services " were wanted, I surmounted my feelings; I should do " the same if you again stood in need of them, but they " are no longer necessary."—She however insisted that he should continue to visit her; he was unable to refuse, but it only tended to confirm the passion that carried him slowly to his grave.

The Chevalier de Menil was set at liberty, but exiled to his estate at Anjou. She was detained some months longer. The correspondence by letters was renewed: but Menil, now at liberty and among his acquaintance, was less passionate and exact than Menil in the Bastile.

"Being at a window, I saw Maison-rouge coming in a "great hurry across the court with a paper in his hand. "He entered my room in a state of perturbation that "alarmed me. While I was looking at him with astonishment, he gave me the paper—it was the lettre de cachet "that set me at liberty:—You are now free, said he, and I "lose you—I most ardently desired this moment—I would "have given my life to procure your liberty—it is obtained, "and I shall cease to see you!—" She was discharged from the Bastile on the 6th of June, 1720.—The cat, that had amused her in her solitude, became the favourite companion of Maison-rouge.—He says, in a letter to her, dated the 7th, "I wished you away—you are gone, and *I am* "*wretched.*"

The robust health of Maison-rouge from this time gradually declined. To restore it, he was sent to drink the waters in his native province, where in a few months he *ended his life*, "*of which he had long been weary.*"

Mademoiselle de Launay resumed her place about the person, and in the confidence, of the Duchess of Maine. But the impatience of de Menil to see her, fell infinitely short of what she had expected. The impressions he had received, while a prisoner like herself, were gone off; and after a few months spent in pretexts on one hand, and disappointment on the other, their connection ended.

Rondell was taken into the service of the Duchess of

Maine.—Mademoiselle de Launay refused several proposals of marriage, and, among others, of Dacier, after the death of his celebrated wife. She at last married Monsieur de Staal, an officer of a good family, but small fortune, and a widower with two daughters. She died at Passy, on the 15th of June, 1750.

SECTION LXXII.

HABIT.

> ——————This is an art
> Which doth mend nature, change it rather; but
> The art itself is nature.
>
> SHAKSPEARE.

There is hardly any delusion by which men are greater sufferers in their happiness than by their expecting too much of what is called pleasure; that is, from those intense delights which vulgarly engross the name of pleasure. The very expectation spoils them. When they do come, we are often engaged in taking pains to persuade ourselves how much we are pleased, rather than enjoying any pleasure which springs naturally out of the object. And whenever we depend upon being vastly delighted, we most frequently go home secretly grieved at missing our aim. Likewise, when this humour of being prodigiously delighted has once taken hold of the imagination, it hinders us from providing for, or acquiescing in, *those gentle soothing engagements, a due variety and succession of which are the only things that supply a continued stream of happiness.* It has been shewn, there is a limit at which they ever afterwards decline. They are by necessity of short duration, as the organs cannot hold on their emotions beyond a certain length of time; and if you endeavour to compensate for this imperfection in their nature, by the frequency with which you repeat them, you lose more than you gain by the fatigue of the faculties and diminution of sensibility. We have in this account said nothing of the loss of opportunities, or the decay of faculties, which whenever they happen leave the voluptuary destitute and desperate; teased by desires that can never be gratified, and the memory of pleasures which must return no more. On the contrary, moderate enjoyment, admitting *frequent reiteration* without diminution, and occupying the mind without exhausting it, gets gradually stronger, till it becomes a HABIT. As business is often painful, and is never pleasant beyond a certain bound, the *habitual* increase of moderate pleasures, are admirably contrived for reconciling us to whatever course of life may be our lot. The HABITS themselves are much the same; for whatever is made *habitual* becomes smooth, and easy, and often almost indifferent. The return of an *old habit* is likewise easy, whatever the *habit* be. Therefore the advantage is on the side of those *habits* which allow of indulgence in the deviation of them. The luxurious receive no greater pleasure from their dainties than the peasant does from his bread and cheese; but the peasant whenever he goes abroad finds a feast, whereas the epicure must be well entertained to escape disgust. Those who spend every day at a coffee-house, reading the magazines and papers, and those who go every day to the plough, pass their time much alike; intent upon what they are about, wanting nothing, regretting nothing, they are both in a state of ease: but then, whatever suspends the occupation of the frequenter of the coffee-house distresses him; whereas to the labourer, every interruption is a refreshment: and this appears in the different effect that Sabbath produces upon the two, which proves a day of recreation to the one, but a lamentable burden to the other. The man who has learned to live alone, feels his spirits enlivened whenever he enters into company, and takes his leave without regret: another, who has long been accustomed to a crowd or continual succession of company, experiences in company no great elevation of spirits, nor much higher satisfaction than what the man of a retired life finds in his chimney corner. So far their conditions are equal : but let a change of place, fortune, or situation, separate the companion from his circle, his visitors, his club, common-room, or coffee-house, and the difference will be then marked. Solitude comes to the one clothed with melancholy : to the other it brings liberty and quiet. You will see the one fretful and restless, at a loss how to dispose of his time, till the hour comes round that he can forget himself in bed: the other easy and satisfied; is ready to admit any little amusement that casts up, or to turn his hand and attention to the first business that shall present itself. A reader who has inured himself to books of science, if a novel, an article of news, a narrative of an interesting voyage, or the journal of a traveller, fall in his way, sits down to the repast with relish, and enjoys his entertainment. Another, with whom nothing goes down but books of humour and pleasantry, seldom can find delight; and when in a bookseller's shop, is more in search of diversion than really diverted, and it is rare that he can enjoy amusement from this innocent source. So important is it to happiness to constitute *habits* not of too great indulgence.

Hence CUSTOM hath a greater influence than any other known cause, to put the rich and the poor upon a level; weak pleasures, the share of the latter, become fortunately stronger by custom ; while voluptuous pleasures, the share of the former, are continually losing ground by satiety, and therefore *real* enjoyment indeed oftener falls from this law, to share of the latter than the former. It is an old and true proverb, Hunger is the best sauce. Objects of taste that are delicious, far from tending to become *habitual*, are apt by indulgence to produce satiety and disgust ; no man contracts a *habit* of sugar, honey, or sweet-meats, as he does of tobacco.

> These violent delights have violent ends,
> And in their triumph die. The sweetest honey
> Is loathsome in its own deliciousness,
> And in the taste confounds the appetite ;
> Therefore love mod'rately, long love doth so ;
> Too swift arrives as tardy as too slow.
>
> SHAKSPEARE.

The same observation, as we have before observed, holds with respect to all objects that, being extremely agreeable, raise *violent passions.* These, by an original law in our nature, increase quickly to their full growth, and decay with no less precipitation: and CUSTOM is too slow in its operation to overcome that law. Exquisite pleasures are extremely fatiguing, occasioning a great expence of the sensorial or irritable principle, and it is wisely ordained, that satiety and disgust shall arise from *reiteration* ; though CUSTOM does exalt more moderate gratifications, and blunt the edge of distress and pain.

Any slight or moderate pleasure frequently *reiterated*, forms a peculiar connection betwixt us, and what causes that pleasure. This connection termed HABIT, has the effect to awaken our desire or appetite for that thing, when it returns not as usual. During the course of enjoyment, the pleasure rises insensibly higher and higher, till a *habit* be established ; at which time the pleasure is at its height. It continues not, however, stationary : the same customary reiteration brings it down insensibly to almost a state of non-action. A *new passion* however, is created; namely, a demand or want of that which was once a strong gratification; and what we have at present in view, is to prove, that those things which at first are but moderately agreeable, are the aptest to become *habitual.* Spirituous liquors, cheese, &c. are at first scarcely agreeable, but they are more especially able to produce this *new passion,* and to become an *habitual* appetite: and *custom* prevails so far, as even to make us fond of things originally disagreeable, such as snuff and tobacco. Nay, instances are not wanting, of people being fond of medicine; and that a face at first disagreeable, being afterwards rendered indifferent by familiarity, and at length agreeable by *custom.*

To introduce a *habit,* frequency of acts is not sufficient without length of time: the quickest succession of acts in a short time is not sufficient, nor a slow succession in the longest time. The effect must be produced by a *moderate soft action,* and a long series of *easy* touches, removed from each other by certain intervals. Nor are these often sufficient without regularity in the time, place, and other circumstances of the action: the more uniform any operation is, the sooner it becomes *habitual.* Thus *custom* hath an effect upon our pleasures, upon our actions, and even upon our thoughts and sentiments.

Habit makes no figure during the vivacity of youth; in the middle age it gains ground; and in old age governs without control. In that period of life, generally speaking, we eat at a certain hour, go to rest at a certain hour, all by the direction of habit: nay, a particular seat, table, bed, comes to be essential; and a *habit* in any of these cannot be controlled without uneasiness. For which reason it seldom answers the expectations of those who retire from their shops and counting-houses to enjoy the remainder of their days in leisure and tranquillity; much less of such, who, after the *habit* of a bustling life, in a fit of chagrin, shut themselves up in cloisters and hermitages; or quit the world, and their stations in it, for solitude and repose. Hence probably the reason why the old Dons of colleges, when they get livings and marry, are so seldom happy.

Thus the pleasure of social intercourse with any person is often at first very faint, but grows into a lasting affection by *reiteration.* Affection thus generated, whether it be friendship or love, seldom swells into any tumultuous or vigorous passion; but is, however, the strongest cement that can bind together two individuals of the human species. In like manner, a slight degree of disgust often reiterated with regularity, grows into a *habit* of aversion, which commonly subsists for life.

A *habit* never fails to admonish us of the wonted time of gratification, by raising a pain for want of the object, and a desire to have it. The pain of want is always first felt; the desire naturally follows; and upon presenting the object, both vanish instantaneously. In pleasures indulged regularly, and at equal intervals, the appetite, remarkably obsequious to *custom,* returns regularly with the usual time of gratification.

Hence a man accustomed to smoke tobacco, at the usual interval feels a confused pain, and the same may be observed in persons addicted to drinking, who are in a very uneasy restless state at the time they are in the *habit* of recurring to the bottle.

The pain of *habit* is less under our power than any other pain that arises from want of gratification: hunger and thirst are more easily endured, especially the first, than an unusual intermission of an *habitual* pleasure: persons are often heard to declare, that they would sooner forego sleep and food, than tobacco.

The pain of want arising from *habit* seems directly opposite to that of satiety. MODERATE PLEASURES are augmented gradually by reiteration, till they become *habitual*, and then they are at their height: but they are not long stationary; for from that point they gradually decay, till they vanish altogether.

The pain occasioned by want of gratification, runs a different course; it increases uniformly; and at last becomes extreme, when the pleasure of gratification is reduced to nothing.

Few experiments have been instituted with a view to shew how far this *accommodating principle* in nature may be extended in different species of plants and animals. It is known, however, that the lamb and the dove can be made carnivorous; and that the hawk, laying aside its natural propensity for flesh, can be brought by art to live upon grain. The horses in Hudson's Bay eat all kind of animal food; and we are assured, by the most authentic authors, that in Iceland, not only black cattle, but also sheep, are almost entirely fed upon fish during the winter season. I have known, says the immortal Hunter, for above thirty years, that the hawk tribe can be made to feed upon bread; for to a tame kite I first gave fat, which it ate very readily; then tallow and butter; and afterwards small balls of bread rolled in fat or butter; and by decreasing the fat gradually, it at last eat bread alone, and seemed to thrive as well as when fed with meat*.

So very much do some individuals of the vegetable tribe *accommodate* themselves to different situations, to soil, to climate, and the state of cultivation, that those naturalists who have not been accustomed to nice and accurate discriminations, have frequently mistaken the variations of the same plants for so many species. These variations may be daily seen, by examining the plant as it grows on the mountains, in the vallies, in the garden, or in the fields; or bringing it from a rude uncultivated state, where it sometimes lays aside its formidable prickles, and changes the colour and structure of its flowers. We may add, that animals covered with down or hair have it thick or thin, long or short, according to the different exigencies of climate.

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* Vide *Observations on the Animal Economy*, by John Hunter, p. 535.

In all living bodies, it frequently happens that several characteristic distinctions, as the colour, the features, and several diseases * which originally were the effect of cir-

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* Nothing is more certain than that there are hereditary diseases, or what comes to the same thing, predisposition to such. Men of fortune and opulence have it in their power to obey the laws of nature and of love; and yet how common are the examples of such men acting an interested part in their matrimonial engagements. Instead of following the dictates of nature, they disregard the high privilege they enjoy, sacrifice their taste, their passion, and often their happiness during life, at the shrine of gold. To accomplish this sordid end, they often embrace deformity, disease, ignorance, peevishness, and every thing that is disgusting to the generous mind. The consequences do not affect them only, but the public. Men of rank, in all nations and governments, are the natural guardians of the state. For these important purposes, their minds should be noble, generous, and bold; and their bodies should be strong, masculine, fit to encounter the fatigues of war, and to repel every hostile assault that may be made upon their country. But, when men of this description, whatever be their motives, intermarry with weak, deformed, puny, or diseased females, their progeny must of necessity degenerate. The strength, beauty, and symmetry of their ancestors, are, perhaps, for ever lost. What is still more to be regretted, debility of body is almost invariably accompanied with weakness of mind. Thus, by the avarice of one individual, a noble and generous race is completely destroyed. By reversing this conduct, it is true, the breed may again be mended; but to repair a single breach, many generations, endowed with prudence and circumspection, will be requisite. A successive degeneration, however, is an infallible consequence of imprudent or interested marriages of this kind. One puny race may for some time be succeeded by another, till at last their constitution become so feeble, that the animals lose even the faculty of multiplying

cumstance, do at last come so fixed in the system, that they are afterwards transmitted to posterity through some generations. With regard to animals and vegetables this fact is undoubted.

SECTION LXXIII.

SOME PRACTICAL OBSERVATIONS ON HABIT.

> If all the year were playing holidays,
> To sport would be as tedious as to work.
> SHAKSPEARE.

There is not a common saying which has a better turn of sense in it, than what we often hear in the mouths of the vulgar, that "*custom* is *second nature*." It is indeed able to form the man anew, and to give him inclinations and capacities altogether different from those he was born with. Dr. Plot, in his *History of Staffordshire*, tells us of an idiot that chancing to live within the sound of a clock, and always amusing himself with counting the hour of the day whenever the clock struck, the clock being spoiled by some accident, the idiot continued to strike and count the hour without the help of it, in the same manner as he had done when it was intire. Though I dare not vouch for the truth of this story, it is very certain that custom has a mechanical effect upon the body, at the same time that it has a very extraordinary influence upon the mind.

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their species. This gradual degeneration is a great cause of the total extinction of some of our noble families. That it should be so, is a wise and beneficent institution of nature; for if such debilitated races were continued, an universal degeneration might soon take place, and mankind would be unable to perform the duties, or to undergo the labour of life. NATURE thus first chastises, and at last extirpates, all those who act contrary to her established laws.

I shall in this paper consider one very remarkable effect which custom has upon human nature; and which, if rightly observed, may lead us into very useful rules of life. What I shall here take notice of in custom, is its wonderful efficacy in making every thing pleasant to us. A person who is addicted to play or gaming, though he took but little delight in it at first, by degrees contracts so strong an inclination towards it, and gives himself up so entirely to it, that it seems the only end of his being. The love of a retired or busy life will grow upon a man insensibly, as he is conversant in the one or the other, till he is utterly unqualified for relishing that to which he has been for some time disused. Nay, a man may smoke or drink, or take snuff, till he is unable to pass away his time without it; not to mention how our delight in any particular study, art, or science, rises and improves in proportion to the application which we bestow upon it. Thus, what was at first an exercise, becomes at length an entertainment. Our employments are changed into our diversions. The mind grows fond of those actions she is *accustomed* to, and is drawn with reluctancy from those paths in which she has used to walk.

Not only such actions as were at first indifferent to us, but even such as were painful, will by custom and practice become pleasant. Sir Francis Bacon observes, in his *Natural Philosophy*, that our taste is never pleased better than with those things which at first created some disgust. He gives particular instances of claret, coffee, and other liquors, which the palate seldom approves upon the first taste; but when it has once got a relish of them generally retains it for life. The mind is constituted after the same manner, and, after having habituated herself to any particular exercise or employment, not only loses her first aversion towards it, but conceives a certain fondness and affection for it. I have heard one of the greatest geniuses this age has produced, who had been trained up in all the polite studies of antiquity, assure me, upon his being obliged to search into several rolls and records, that notwithstanding such an employment was at first very dry and irksome to him, he at last took an incredible pleasure in it, and preferred it even to the reading of Virgil or Cicero. The reader will observe, that I have not here considered *custom* as it makes things easy, but as it renders them delightful; and though others have often made the same reflections, it is possible they may not have drawn those uses from it, with which I intend to fill the remaining part of this section.

If we consider attentively this property of human nature, it may instruct us in very fine moralities. In the first place I would have no man discouraged with that kind of life or series of action, in which the choice of others, or his own necessities, may have engaged him. It may perhaps be very disagreeable to him at first; but use and application will certainly render it not only less painful, but pleasing and satisfactory.

In the second place I would recommend to every one that admirable precept which Pythagoras is said to have given to his disciples, and which that philosopher must have drawn from the observation I have enlarged upon: "*Optimum vitæ genus eligito, nam consuetudo faciet jucundissimum*;" "pitch upon that course of life which is the most excellent, and *custom* will render it the most delightful." Men, whose circumstances will permit them to choose their own way of life, are inexcusable if they do not pursue that which their judgment tells them is the most laudable. The voice of reason is more to be regarded than the bent of any present inclination, since by the rule above mentioned, inclination will at length come over to reason, though we can never force reason to comply with inclination.

In the third place, this observation may teach the most sensual and irreligious man to overlook those hardships and difficulties, which are apt to discourage him from the prosecution of a virtuous life. "*The gods*" said Hesiod, "*have placed Labour before Virtue; the way to her is at first rough and difficult, but grows more smooth and easy the further you advance in it.*" The man who proceeds in it, with steadiness and resolution, will in a little time find, that "*her ways are ways of pleasantness, and that all her paths are peace.*"

In the fourth place, we may learn from this observation which we have made on the mind of man, to take particular care, when we are once settled in a regular course of life, how we too frequently indulge ourselves in any the most innocent diversions and entertainments, since the mind may insensibly fall off from the relish of virtuous actions, and, by degrees, exchange that pleasure which it takes in the performance of its duty, for delights of a much more inferior and unprofitable nature.

The last use which I shall make of this remarkable property in human nature, of being delighted with those actions to which it is accustomed, is to shew how absolutely necessary it is for us to gain *habits* of virtue in this life, if we would enjoy the pleasures of the next. The state of bliss we call heaven will not be capable of affecting those minds, which are not thus qualified for it; we must, in this world, gain a relish of truth and virtue, if we would be able to taste that knowledge and perfection, which are to make us happy in the next. The seeds of those spiritual joys and raptures, which are to rise up and flourish in the soul to all eternity, must be planted in her during this her present state of probation. In short, heaven is not to be looked upon only as the reward, but as the natural effect of a religious life.

On the other hand, those evil spirits, who, by long custom, have contracted in the body *habits* of lust and sensuality, malice and revenge, an aversion to every thing that is good, just, or laudable, are naturally seasoned and prepared for pain and misery. Their torments have already taken root in them; they cannot be happy when divested of the body, unless we may suppose, that Providence will, in a manner create the *mind* anew, and work a miracle in the rectification of their faculties. They may, indeed, taste a kind of malignant pleasure in those actions to which they are accustomed, whilst in this life; but when they are removed from all those objects which are here apt to gratify them, they will naturally become their own tormentors, and cherish in themselves those painful habits of mind which are called, in Scripture phrase, "*the worm which never dies.*"

> To be good is to be happy; angels
> Are happier than men, because they're better:
> Guilt is the source of sorrow; 'tis the fiend,
> Th' avenging fiend, that follows us behind
> With whips and stings: the bless'd know none of this,
> But rest in everlasting peace of mind.

This notion of heaven and hell is so very conformable to the light of nature, that it was discovered by several of the most exalted heathens. It has been finely improved by many eminent divines of the last age, as in particular by Archbishop Tillotson and Dr. Sherlock: but there is none who has raised such noble speculations upon it as Dr. Scott, in the first book of "*The Christian Life,*" which is one of the finest and most rational schemes of divinity, that is written in our tongue, or in any other. That excellent author has shewn how every particular custom and habit of virtue will, in its own nature, produce the *heaven*, or a state of happiness, in him who shall practise it: as on the contrary, how every custom or habit of vice will be the natural *hell* of him in whom it subsists.

Many parents, by studying the health and comforts of their children, bring on *habits* that prove the sources of perpetual sickness, or the certain presages of an early death. The mother certainly forsakes the intention of Nature when she carries her fondness to excess; when she makes an idol of her child; increasing his weakness by preventing its sense of it; and, as if she could emancipate him from the laws of Nature, tries to prevent every approach of pain and distress; not considering, that for the sake of preserving him at present from inconveniences, she is accumulating on his head a load of anxieties and misfortunes, and, by bringing up her child in softness and effeminacy, she absolutely renders him *more tender* and *vulnerable*; and *lays open*, as it were, his nerves to every species of afflicting sensations, to which he most assuredly will fall a prey as he grows up.

Nor do I recommend the opposite extreme. The middle is the only right path. When men, whom the world hath celebrated for profound thinking, speculate upon innate ideas, or liberty and free will, they may be permitted to have their opinion; but when they allege * that children are to be every day plunged into cold water, and, whatever be their constitutions or parents, indiscriminately enured to cold and moisture; that they are to have no covering on their feet; and are to go half naked, &c. These are such noxious errors, that all reasonable men should endeavour to oppose them. Many have been the children whom these opinions, begun in speculation, have injured or destroyed in practice, and I have seen many a little philosophic martyr whom I wished, but was unable, to relieve.

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* Vide Locke's *Treatise on Education.*

SECTION LXXIV.

A VINDICATION OF THE WISDOM AND GOODNESS OF GOD IN ESTABLISHING GENERAL LAWS.

> Nec Deus intersit, nisi dignus vindice nodus
> Inciderit.——— HOR.

> All NATURE is but *art* unknown to thee:
> All CHANCE, *direction*, which thou canst not see;
> All DISCORD, *harmony* not understood;
> All PARTIAL EVIL, *universal good*:
> And spite of Pride, in erring Reason's spite,
> One truth is clear, "WHATEVER IS, IS RIGHT."
> POPE.

As men are unable, says the celebrated historian Robertson, to comprehend the manner in which the ALMIGHTY carries on the government of the universe, by *equal*, *fixed*, and *general laws*, they are apt to imagine that, in every case which their passions or interest render important in their own eyes, the SUPREME RULER of all ought visibly to display his power. It requires no inconsiderable degree of science and philosophy to correct this popular error. Religion, for several centuries, consisted chiefly in believing the legendary history of those saints whose names crowd and disgrace the Romish calendar. The fabulous tales concerning their miracles had been delared authentic by the bulls of popes and the decrees of councils; they made the great subject of the instructions which the clergy offered to the people, and were received by them with implicit credulity and admiration. By attending to these, men were accustomed to believe that the *established laws* of nature might be violated on the most frivolous occasions, and were taught to look rather for particular and extraordinary acts of power under the divine administration, than to contemplate the *regular progress* and *execution* of a *general plan.*

It has been before proved, that it is the same with the physical as with the moral world.

> ——————" The UNIVERSAL CAUSE
> " Acts not by *partial* but by *general laws.*"

The mechanism of our body, the connection and subserviency of all its parts to a common purpose, the exquisite contrivance of its organs, consisting of all the various orders of vessels, interwoven with wonderful art, have led anatomists in all ages to acknowledge an infinitely wise, omnipotent, and benevolent power. It is, indeed, otherwise inconceivable how such consistency and harmony could have taken place in the different parts of our wonderful frame. How they could have been so exactly fitted to each other, and to the exterior objects, which have an evident relation to them, and the system they compose. In the most inconsiderable, as well as in the most illustrious works of the CREATOR, consummate art and design appear. There is not a creature that moves, nor a vegetable that grows, but, when minutely examined, furnishes materials of the highest admiration. The same wisdom that placed the sun in the centre of the system, and arranged the several planets around him in their order, has shewn itself equally in the vegetable and animal creation. Besides the footsteps of his wisdom and goodness, as it were, upon their surfaces, there are many curious and excellent tokens and effects of Divine power in the hidden and innermost recesses of them.

But these are not to be seen by the slight glances of the lazy and ignorant; but require the most attentive and prying inspection of the curious and the learned.

In the structure of the universe men are very ready to confess, that all is great and beautiful. They adore the hand that could launch forth into the boundless region of space this immense globe, with all its load of created beings, who appointed its revolution daily round its own axis, and its annual course in perpetual circuit round the sun; who marked out the monthly journey of the moon, and the different courses of the other planets; who hath so appointed them, that it is now reckoned even a criminal error for an astronomer to miss even a minute in the calculation of their times,—but in the government of human affairs, and the laws of the animated fibre, they complain of great imperfection and irregularity.

Have they not yet learnt that effects depend on causes, that these are linked together, and that both proceed from the same AUTHOR? Have they forgotten, that he who balanced all the heavenly bodies, and adjusted the proportions and limits of nature, is the same who hath allotted them their condition in the world, who distributes the measures of their prosperity and adversity, and fixes the bounds of their habitation? If their lot appear to them ill-sorted, and their condition hard, let them only put the question to their own minds, whether it be most probable, that the great and wise CREATOR hath erred in his distribution of human things, or that they have erred in the judgment which they form concerning the lot assigned to them? For how many clear marks of benevolent intention appear every where around us! What a profusion of beauty and ornament is poured forth on the face of nature! What a magnificent spectacle presented to the view of man! What supply contrived for his wants! What a variety of objects set before him, to gratify his senses, to employ his understanding, to entertain his imagination, to cheer and gladden his heart! Indeed the very existence of the universe is a standing memorial of the goodness of the CREATOR. For nothing except goodness could originally prompt creation. The SUPREME BEING, self-existent and all-sufficient, had no wants which he could seek to supply. No new accession of felicity or glory was to result to him from creatures whom he made. It was goodness communicating and pouring itself forth, goodness delighting to impart happiness in all its forms, which in the beginning created the heaven and the earth. Hence those innumerable orders of living creatures with which the earth is peopled; from the lowest class of sensitive being, to the highest rank of reason and intelligence.

Every thing in this world is systematical; all is combination, relation, affinity, connection. There is nothing but what is the immediate effect of something preceding it, and determines the existence of something that shall follow it. The DIVINE MIND, which at once comprehended all the relations of things, saw from the first the true good. Therefore there is not in the universe any such thing as absolute evil; because it contains nothing in itself but what is the cause of some good, which could not have existed, as things are, without the possibility of evil. Had every thing stood unconnected, there would have been a chasm in the chain; and from an universal concatenation the *subordination* of beings result, and their relation to space and time. Shall the wheel of a machine complain that it is not the main spring? and this last, were it to become a wheel, would make the same complaint: so that, in order to put an end to expostulation, it would be necessary to annihilate the machine itself. You ask, why is not man formed as perfect as an angel? You mean to say, no doubt, why is not a man an angel? You may as well inquire, why a stag is not a man? But the existence of a stag supposes that of herbs to nourish him. Would you still further have these herbs to have been so many men? Their preservation and increase depend on the earth, the air, the water, and the sun's beams. Would you persist in your desires? Rather confess your error, and acknowledge that every being is endued with a perfection suited to the ends of its creation. It would cease to answer that end, the very moment it ceased to be what it is. By changing its nature, it would change its place; and that which it occupied in the universal hierarchy, ought still to be the residence of a being resembling it, otherwise the harmony of the whole would be destroyed. Let us not then judge of beings considered in themselves; but let us estimate them with regard to the place they should hold in the system. Certain consequences arising from their nature, are they evils? In order to prevent those evils from existing, it would have been necessary to leave them in their state of nonentity, to have constantly interposed, or to have created another universe. But let us rather contemplate this life as an introduction to a greater and nobler system in the government of God. Temporal things are to give place to things eternal. The earth is employed as a theatre, on which the human generations are successively to come forth, and to fulfil their term of trial. As long as the period of trial continues, much obscurity must of course cover the counsels of Providence. It is appointed that the earth should be governed by *general laws*; hence the righteous often seem neglected by heaven, and the wicked are allowed externally to prosper. Suited to a condition of trial is the state and form of the world which we now inhabit. It is not designed to be a mansion for innocent and happy spirits; but a dwelling for creatures of a fallen nature *, and of mixed character. Hence, those contrasts of pleasure and pain, of disorder and of beauty, with which it abounds. Hence, some regions of the earth presenting gay and pleasing scenes, others exhibiting nothing but ruggedness and deformity: the face of nature sometimes brightened by a serene atmosphere and a splendid sun, sometimes disfigured by jarring elements and overcast with troubled skies. Had any one beheld the earth in a state of chaos; when the elements lay mixed and confused; when the earth was without form and void, and darkness was on the face of the deep: would he have believed, that it was presently to become so fair and well ordered a globe as we now behold it; illumined with the splendor of the sun, and decorated with all the beauty of nature? The same powerful hand, which perfected the creation, and made light spring from primæval darkness, will in due time make order arise from the seeming confusion of the world. This earth was never intended for more than the outer court, the porch, through which the righteous were to pass into the temple and sanctuary of the DIVINITY. When that which is perfect is come, that which is in part shall be done away.

The heavens declare the glory of GOD, and the firmament sheweth his handy work. The sublime writer, who thus expresses himself, was nevertheless un-

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* "*For* WHOSE *sin was he* BORN *blind?*" escaped every learned writer, until the subject was taken up by the benevolent Soame JENNINGS. Let those, who wish sincerely to understand *the fall* of our first parents, as given us by MOSES, consult Michael RAMSAY, the friend of FENELON, Archbishop of CAMBRAY; who, like him, was possessed of an enlarged mind, unbiassed by the prejudices of education, and gave a *spiritual interpretation* to that most interesting narrative.—The different denominations of CHRISTIANS may be divided into two great sectaries, those who make a *literal* interpretation of Scripture, and those who understand it *figuratively*, according to the Eastern manners.

apprised that the stars which he contemplated were in reality suns.

This assemblage of vast bodies is divided into different systems, the number of which perhaps exceeds the grains of sand which the sea casts on its shores.

Each system has its centre or focus, either a star or sun, which shines with its own light, and round which revolve various orders of opaque globes, which reflect with greater or lesser lustre the light they borrow from it, and which renders them visible to us.

These, which seem to wander among the heavenly bodies, are planets, the principal of which have the sun for the common centre of the periodical revolutions; whilst the others, which are called secondary, move round one principal planet, which they accompany like satellites, in its annual revolution.

Venus and the Earth have each of them their satellite. One will undoubtedly be some time or other discovered in Mars. Jupiter has four, Saturn five, and a ring or luminous body which seems to perform the office of a number of small moons. Being situate near three hundred millions of leagues from the sun, he would have received too faint a light from it, if his satellites and ring did not augment it by reflection.

We have discovered twenty-seven planets, which at present compose our solar system; but we are not certain that there are not more of them. Their number has received a great increase by the invention of telescopes: more perfect instruments, and more assiduous and accurate observers, may probably make some further addition to them. The satellite of Venus, of which there was a discovery made in the last century, and of the Georgium Sidus in the present, gives room for astronomers to hope for a still greater augmentation of their number.

The diameter of the great orbit, which our planet describes round the Sun, is more than sixty millions of leagues, and this vast circumference vanishes into nothing, and becomes a mere point, when made use of by astronomers to measure the distance of the fixed stars.

How great then must be the real bulk of those spotlike stars, that are perceivable by us at such an enormous distance! The sun is about a million times greater than the earth, and an hundred and ten times greater than all the planets put together. If the stars are suns, as their lustre gives us reason to suppose, how greatly must they surpass ours in size!

Proud, short-sighted mortal! Lift up now thine eyes to the heavens, and answer me: though one of those luminaries which adorn the starry arch should be taken away, would thy nights become darker on that account? Do not then say, the stars are made for me, it is for my sake that the firmament glitters with effulgent brightness.

If those globes that equal, or even far surpass the size of our planet; if such globes as turn, like the earth, round the sun and on themselves; if such globes as are the common centre of the revolutions of one or several moons; if such globes wherein we may perceive divers things resembling or analogous to what we see on earth; if these globes, I say, were without *inhabitants*, for what they were designed, or for what end *?

How mean and unworthy of the adorable majesty of the CREATOR would the universe appear, were it confined to the narrow limits of that little heap of dirt we crawl upon? Let us aggrandize our minds, by extending the bounds of the universe. The stars, when seen through a telescope, are inumerable: their sparkling affords a proof that they shine with their own light; and since they are visible to us at incomparably greater distances than Saturn, we may from thence infer that they are so many suns. Our sun, if viewed from a star, would itself appear like a star. There must then be an infinite number of suns; and to what purpose would they serve, if there were not *beings* capable of enjoying the advantages of their light and heat. Is it not therefore natural to suppose, that they give light to other worlds, which their prodigious distance deprives us of, and that they have, like ours, their *productions* and *inhabitants.*

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* "*In my Father's house there are many mansions,*" is the language of Scripture. These chambers, or mansions, it is reasonable to suppose, are the different stars adapted to their respective guests, and in them we shall probably be in a probationary state, until we arrive at an immutable perfection.

Could the omnipotent Creator call into existence this earth, adorn it with so much beauty and splendour, and surround it with so many glorious luminaries, which we behold in the heavens, only that some generations of mortal men might arise to gaze at these wonders, and then disappear for ever? Could the all merciful Creator adjust effects to causes, and yet leave these sometimes to injure the creatures of his own hands, without intending another life after this? Are the wicked to prosper here, and the righteous go unrewarded? No; we shall be called ere long to reside among celestial spirits, we shall eternally advance from perfection to perfection, and every instant of our duration will be distinguished by the acquisition of farther degrees of happiness; until we shall at last arrive at the presence of our Creator.

SECTION LXXV.

ON THE ESTABLISHMENT OF THE PNEUMATIC PRACTICE OF PHYSIC, FOR THE RESTORATION OF HEALTH.

The introduction of *aerial remedies*, for the removal of disease, has produced a new æra in the practice of physic.

Whilst Dr. Beddoes went from Oxford to the Hot Wells, Bristol, chiefly with a view to remove consumption, by abstracting the oxygen from the air, his friend Dr. Thornton, on a large scale, began to try the effects of the addition of oxygen to common air, and the result of such cases he communicated to Dr. Beddoes, or to the Philosophical Magazine. Other labourers in this new practice also, have appeared to enrich the harvest of useful discoveries for the benefit of mankind.

We shall follow the order of anatomy in relating the cases, beginning with the diseases of the head.

I. HYDROCEPHALUS, OR DROPSY OF THE BRAIN.

Case 1.—*Lydia Johnson, under Dr. Thornton, cured. Vide No. XVIII. of the Philosophical Magazine, page* 196.

Blindness complete, pupils greatly dilated, which originated from a putrid fever violently affecting the brain; had fits very frequent. By encreasing the quantity of *vital air* to 12 quarts, sight was suddenly restored whilst inhaling.

Case 2.—*Thomas Mead, under Dr. Thornton. Remarkable cure. Vide Part III. of Dr. Beddoes' Considerations, page* 11.

Six weeks in St. Thomas's Hospital, dismissed as incurable by Dr. Fordyce. Messrs. Wathen and Phipps, oculists, thought the case incurable. Pupils dilated, pulse sluggish, subject to fits. In three days after inhaling the *vital air* began to distinguish objects. Sight improved daily; and his fits left him.

II. AMAUROSIS, OR GUTTA SERENA.

Case 3.—*Hon. Miss W——, under Dr. Thornton, cured. Vide Part III. of Dr. Beddoes' Considerations, page* 78.

Under the care of Messrs. Wathen and Phipps. Could not tell the hour from the Horse-Guards clock; after six weeks was enabled to distinguish the hour very readily.

Case 4.—*Mrs. Benham under Dr. Thornton—Dr. Beddoes.*

In ten days after inhaling the *vital air,* could read a small print, which she could not do before.

III. DEAFNESS FROM AN ULCER IN THE EAR.

Case 5.—*A boy, under Dr. Thornton and Mr. Hill, cured. Vide Part II. of Dr. Beddoes' Considerations.*

So deaf as not to hear the tower guns: could hear after a short time even a rap at the door, or any other loud noise.

IV. OPHTHALMIA, OR CHRONIC INFLAMMATION OF THE EYES.

Case 6.—*Miss Goudy, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XII. page* 418.—*Communicated by Dr. Thornton.*

Miss Goudy, æt. 11, living No. 171, High-street, Shadwell, had been subject to occasional attacks of the eyes for eight years past. In one attack, some years ago, a skin formed over the right eye, which was removed by a caustic powder blown into it by order of Mr. Sharp, and sight was restored in about a month: this eye has, however, since been subject to become inflamed upon the least cold, when the face enlarges prodigiously, looks red as fire, with intense burning. She had taken a great quantity of medicine under Messrs. Young, Ward, Evans, &c. without any marked advantage, previous to her parents making application to me.

When I saw her, her right eye was much inflamed, and the upper lips and cheeks were tumefied in a frightful degree. It was a new case, that required much consideration. Were the vessels in a state of inflammation from tone, or from debility? Examining the arms I found them remarkably blue and mottled, the feet were always uncommonly cold, the appetite craving, or else none, much flatulency, great distention of the abdomen at times, and a tendency to chlorosis. The pulse small, and quick. I accordingly ordered the *super-oxygenated air*, November 27, 1798, gradually augmenting its power.

Memorandum—December 4, feels always a great glow over the whole body, after inhaling the *vital air*. Inflammation of the eye gone. I ordered a seton in the neck, to hinder a relapse, by its inviting the blood to a neighbouring part, and setting up a new action: and without fear I now pursued the tonic and stimulant plan, viz. bark, myrrh, and steel, and a *super-oxygenated air* *; and my young patient was soon perfectly cured, and continues so, I am happy to say, to this day.

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* The proportion was generally six quarts *vital air* mixed with twenty of atmospheric.

V. HEADACHE.

Case 7.—*Mrs. S——, under Dr. Darwin, cured. Vide Part II. of Dr. Beddoes' Considerations, page* 63.

A pertinaceous headache, and so far reduced as not to be able to rise from her bed. She always, says Dr. Darwin, found herself revived by the inhalation, and gradually recovered her health, and became stronger than she had been for some years, and freer from the pains in her head.

Case 8.—*Mr. Monier, under Dr. Thornton. Vide Part IV. of Dr. Beddoes' Considerations, page* 134, *cured.*

The headache was accompanied with stupor, and frequent giddiness, and had continued unremittingly for six weeks.

VI. MANIA, OR MADNESS.

Case 9.—*Mr. Windy, under Dr. Thornton, cured. Vide Part III. of Dr. Beddoes' Considerations, page* 109, *and the Rev. Mr. Townsend's Elements of Therapeuticks, Vol. I. page* 2.

He was gloomy, sullen, and silent, or muttered only expressions which evinced the terrors of his disturbed imagination. He had no recollection of his wife or children, and the only notice he took of his attendants, was to manifest suspicion that they meant to injure him. He made several attempts to destroy himself.

In ten days from the time of his inhaling the *vital air*, he became conscious of the presence of his wife and children, and shortly after his reason returned, and he was able to conduct his own affairs.

VII. EPILEPSIA, OR EPILEPSY.

Case 10.—*Miss Yrujo, under Dr. Thornton, cured. Vide Philosophical Magazine, Vol. XXIV. p. 246.*

Miss Lavinia de Yrujo, æt. 10, at Mrs. Baylis's school, Brook Green House, Hammersmith. She had a fit at three years old: then her next attack was when five years old: when eight, they would attack her two or three times a week. She used to faint; and her eyes became fixed, her fingers clenched, and all her limbs completely rigid; the eyes would remain wide open and fixed: this would continue a quarter of an hour. Had many fits before she applied to me, in October 1804, when one came on at two and continued till seven. Mr. Flower was sent for, who judiciously employed the usual restoratives, and then advised the young lady to be sent home for further advice. She began the inhalation of a gallon of *vital air*, diluted, once a day, with the usual tonic remedies; and has not had a fit now, September 16, 1805, a whole twelvemonth. She only took the *vital air* for three weeks, and has not had any medicine, or the least occasion for any, since. She is now before me, with her mother, perfectly well; and is returned to her school at Hammersmith. The apothecary to the family, and several other medical gentlemen, had pronounced, to the mother and family, this case as one *that never could be cured by art.*

Observations on this Case by Dr. Thornton.

1. These cases yield to the *vital air* when all other remedies fail. The cause is, that the *vital air* gives energy to the muscles, and thence to the nerves, taking off inordinate action from an undue balance of principles.

2. And hence it is, that persons breathing much *bad air* become, on the contrary, convulsed.

3. The very first day of inhaling the *vital air*, the fits altogether ceased.

I am, &c,

Robert John Thornton.

Case 11.—*Charles Wayte Dare, under Mr. Hill, cured. Vide Philosophical Magazine, Vol. XXIV. page* 246.

Charles Wayte Dare, son of Mr. Dare, Dowgate Hill, is a young man who appeared strong and healthy until eleven years of age. At that period, being very abruptly informed that his father's house was on fire, the shock affected him so much as to throw him into an epileptic fit. From this time the paroxysms failed not to return every three or four weeks; and though, during the course of some years, the number of his fits did not much increase, his bodily strength and mental faculties were considerably impaired. Several medical men were consulted on the first attack, but the remedies prescribed by them gave little or no relief. On his becoming deaf in one ear, and his eye-sight failing him, whatever he learned at the Blue-coat School was forgotten, owing to the violence of the fits. His parents, therefore, thought it advisable to take him home. At length, having received some benefit from medical aid, his father placed him on trial at Mr. Davison's, in Sise-lane; but a fright soon bringing back all his former disorders, he was obliged to return again to his family. His fits were now exceedingly violent, and their frequency increased to a considerable number in twenty-four hours. In consequence of this he became more deaf than ever, his vision weaker, and his intellects so materially injured that it was impossible to leave him alone, for fear he should either fall into the fire, or meet with some other calamitous accident. In this deplorable state he was put under my care early in March 1796. The morning previous to my seeing him, his fits had been so particularly violent as to exhaust him greatly, and his pulse beat above one hundred in a minute. It was not without infinite difficulty that I could either persuade him or make him comprehend in what manner, to inhale *vital air* from my apparatus; and the general torpor of his mind, extreme debility of body, and deafness, gave me but faint hopes of his recovery. However, after he had inhaled a moderate dose of *vital air*, an unusual warmth diffused itself over his whole frame, accompanied with a considerable degree of perspiration. He afterwards passed the whole day, and the following night, without any return of fits; a circumstance which had not happened for several months. The next morning he was tolerably cheerful; his hearing and vision less defective; and his pulse more firm, beating ten strokes less in a minute than the preceding day. On having again recourse to the *vital air*, it revived him as before, and the second day passed without a fit: but he found a disposition to fulness in his head, and such a tendency to falling down during that day, that it would have taken place, had not his own exertions prevented it. The third morning, before he came to my house, he was attacked with a very slight fit. Finding in him this tendency to local fulness in the head, I employed cupping, and an opening medicine. By paying due attention to the fulness in the head, and keeping the bowels properly open, the pulse became regular; while the active effects of the *vital air* so invigorated his constitution, that he not only lost his fits, but in six weeks gradually regained his vision and hearing, and was able to walk six or seven miles a day, without fatigue, or any inconvenience whatever. Some sultry weather coming on in the month of May, he became nervous; had the head-ach, and some slight degree of fever, after a fatiguing walk to Hampstead; and for the second time only experienced a trifling relapse. I now directed him to be bled with leeches on the temples, and to take the usual dose of opening medicine; after which, as soon as the fever had subsided, he was to have recourse to the bark and *vital air*, at different intervals, until the middle of July. He then became perfectly well in health, strength, and spirits; and in December 1797 his father engaged him in the house of Messrs. Hopkins and Lincoln, where he now resides; and, not having had any return whatever of his former complaints, he is fully enabled to keep such accounts as require a mind perfectly free from every degree of oppression or irritation.

"*To Mr. Hill.*

"Sir,

"I can with pleasure inform you, that my son, Charles Wayte Dayre, has, by the blessing of God, with your kind attention to him, and the help of *vital air*, received a very great cure from his deafness, nervous complaints, and fits, which had long affected him; and they increased on him so fast, that, when he applied to you, he had from sixteen to twenty a day. He could not be left at any time, even a quarter of an hour in a day. He has not had a fit these eighteen months, or near two years.

"I am, sir,

"Your greatly obliged humble servant,

"Charles Dayre."

Observations on this Case by Mr. Hill.

However the general appearance of this young man may have been as to strength, some peculiarity of habit, as irritability of stomach and bowels, most likely had existed, and was a predisposing cause of the complaint. Be this as it may, any sudden surprise or misfortune will almost always produce some determination of blood to the head, more or less violent, in the strongest frame. In this case, as in many others, it laid the foundation of very serious mischief. In length of time it exhausted the nervous energy; and the powers of life, depending on an equable circulation, were reduced to extreme debility. Under these circumstances no remedy, one short instance excepted, arrested the progress of the disease, still less gave hopes of a recovery. The success in this case was beyond my expectation; for I was apprehensive that the several organs of sense, as the eyes and ears, were become paralytic from some organic defect in the brain, owing to the long continuance, violence, and frequency of the attacks. Contrary to my conjecture, however, the patient was relieved much in the same manner as the subject of the preceding case; and, as the same consequences followed, nearly the same reasoning applies to both; viz. some material change in the system was wrought by the chemical union of *vital air* in the blood, the secretions by the skin and kidneys were promoted, and the energy and strength of the nerves were restored, when tonic remedies recovered the chylopoietic viscera to their due functions.

I cannot avoid particularly observing, that this lessening of the determination of blood to the head, is a fact of great importance of all people subject to fits or nervous head-achs.

Case 12.—*Mrs. Paynter, under Dr. Thornton. A cure produced. Vide Dr. Beddoes' Considerations, Part V. page* 20.

Mrs. Paynter, who lives at No. 2, Brompton-terrace, came to consult me. She had been subject to hysterics, faintings, and epileptic fits, for more than seven years. Having first premised an emetic and cathartic, and cleared away the superabundant mucus of the primæ viæ, I then gave the *vital air*; and the accelerated blood meeting with no obstruction in the aorta, diffused heat through the whole system. To prevent the glands, or exhalant arteries, of these parts, from throwing out too much mucus, I next gave tonics, as bark, myrrh, and steel; and, by using occasional evacuations, continuing the daily inhalation of the *vital air*, after ten days the fits no longer made their appearance, and her appetite, complexion, and sleep returned; and at the end of six weeks her constitution was so firmly established, as to need no more medicine or air.

VIII. SCROPHULA, OR KING'S-EVIL.

Case 13.—*Miss Holmer, under Dr. Thornton, cured. Vide Number IX. of the Philosophical Magazine, p.* 90.—*Communicated by Dr. Thornton.*

Miss Holmer, æt. 18, an amiable and accomplished young lady, the daughter of a wholesale ironmonger in the Borough, so early as at the age of seven had the glands of the neck beginning to take on disease. First one gland under the ear, then another, and by degrees all the glands about the neck became enlarged, and went on gradually increasing. The same disposition also shewed itself by an affection of the eyes, for which this lady was nine months under the care of Mr. Ware. During the progress of glandular affection, she was under Messrs. Kent, Fearon, Bayley, &c. &c. and Dr. Saunders. Mercury was used externally and internally, until the teeth become loosened; bark, and steel, and soda, or fossil alkali, given in profusion; but each practitioner in turn relinquished the case, recommending sea air, which was had recourse to at sundry times. This young lady was latterly referred to John Hunter, who employed Hemlock to an uncommon extent; and he also, as the sea air had been before tried without advantage, advised the parents to do nothing further, saying, with his usual bluntness, "that it was a case of that nature that whoever would undertake the cure would do it only with the intent of picking their pockets."

When I first saw the young lady, I observed the glands of the throat, even from the nape of the neck, so enlarged as to defeat all concealment, and forming one apparently homogeneous mass, extended even over the jaw-bones, which could not be felt, and suffocation was threatened by pressure on the wind-pipe. Her relations ridiculed the idea of any farther application for this disease; but parental fondness urged an inquiry relative to the *airs*. The Rev. Mr. Townsend, rector of Pewsey, author of a very excellent work on physic, Elements of Therapeutics, happened to be at my house when the lady arrived. Although he conceived highly of pneumatic medicine, as may be seen throughout his work, he told me, "that he must consider "me as very bold if I could venture to undertake such a "case, which he acknowledged to exceed any thing he "had ever before seen;" and Mr. Jones, an eminent apothecary in Mount-street, declared, that if I produced a cure here, all he could say was, "that miracles had not ceased." I, however, was not discouraged, and the event has proved that we should not, having such new and powerful agents as the *airs*, readily give way to despair.

In a month after commencing the inhalation of *vital air* (six quarts daily mixed with thirty of atmospheric), the knot of glands began to soften, yielding a little to external pressure; by degrees they separated from each other, and thirteen glands could be directly made out; the jawbones became liberated; and these, whether from pressure of the glands, or imperfect ossification, were bent up a little from their natural course; and, not to tire the reader, I shall finally remark, that in less than eight months the decrease was five inches by measurement round the neck! The hands, which before were unusually cold, were comfortably warm during the whole time the *vital air* was inhaled, and the appetite and spirits increased. Mr. Cruickshank observed, that during the time of inhaling the *superoxygenated air*, the pulse was raised about six beats in a minute, and became stronger. I must beg leave to mention here, that I also roused the absorbents by both topical as well as internal remedies. But why I place such a stress on the power of the *vital air* over this system of vessels, is, that from the experiment of Dr. Beddoes, which he made upon himself, while inhaling a *superoxygenated air*, he became, he observes, considerably diminished in bulk, although he ate twice as much as before, which I conceive could only arise from the superior energy given to the absorbents by the *vital air*.

Case 14.—*Mary Buchanan, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. p.* 144.—*Letter from Dr. Thornton to Dr. Beddoes.*

Mary Buchanan, aged 8, lives at No. 2. Whitcomb-court, Haymarket; from the account of her mother she was weakly from her infancy. She was two years and a half before she walked; her limbs were crooked, understanding remarkably acute, under lip prominent, eyes black, hair lank; was troubled with worms, both the teretes and ascarides; for which she took Evans's powder, which brought away much slime, and many worms; but, from these powerful evacuations, she was much debilitated, and became subject to profuse perspirations, and for a long while was constantly ailing; when, whether from cold, or what other cause, or the nature of scrophula, I cannot determine, she was seized with deafness; and afterwards with such an inflammation of her eyes, that she was blind for above ten days: leeches were applied to the temples with some effect; but these symptoms only seemed to retire, to give way to a more formidable symptom, namely, an enlargement of a gland of the neck on the left side, which, for three months, kept on increasing both in size and hardness; and the child continually leaning on that side, the head became immovably sunk; so that the ear, night and day, nearly rested on the left shoulder. The countenance of the child was pale, body costive, belly large and hard, breath offensive, particularly so towards morning, feet cold, itching of the nose, appetite often keen, but there was no starting in her sleep, grinding of teeth, or any worms observed in her evacuations, although much mucus. She was placed and continued under the care of my friend, Mr. Hill, a week. He gave her rhubarb and vitriolated kali, night and morning. Sorrel poultices were applied to the neck, the *vital air* was inhaled, and the case was going on very well, when Mr. Hill had occasion to leave town, who requested I would undertake the case for him.

I followed Mr. Hill's practice, and in addition used electricity on the tumour, and directed a tonic mixture of bark and steel, keeping the body gently open with powders. The tumour was at this time the size of a goose's egg, and very hard. Since the application of the sorrel, it was looking somewhat red. In a week there was produced a considerable softening, accompanied with violent pains and restless nights. I ordered an opiate in the evening.

In a few days after this I made a scratch, on the most depending part, with a lancet; and repeating this three successive days, on the fourth there issued through this small orifice a bloody serum. I now directed a bread and milk poultice, discontinued the opiate, and increased the proportion of steel. For several days the bloody serous discharge continued, when I ordered the *sorrel* poultice to be resumed. Almost instantly the purple tumour was rendered florid, the lips of the orifice became of a bright red, violent pain was excited, and, on the next day, matter of some consistency was formed. I moderated the action, when too strong, by a bread poultice; and I sometimes interposed the rhubarb aperient; and, by always keeping up a due action, in a month the tumour was wholly removed; the child can now turn her head in all directions; she has the appearance and manners of health; and, instead of being disfigured, there remains now a scar not larger than a pea, and not discernible but upon the closest inspection.

Case 15.—*Mr. Cooper, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page* 71.—*Letter from Mr. Cooper to Dr. Beddoes.*

Dacre-street, Westminster, July 29, 1795.

SIR,

I was above nine months afflicted with hard tumours, which were very slow to suppurate, and when they did, produced only a watery discharge, and a sore, that took a long time in healing. These appeared chiefly about the throat. Previous to this, I had frequent eruptions on my face, for which I was often purged and bled, which in my opinion might have produced the disorder I am attempting to describe to you. It soon became necessary to try every means to get rid of it, and I took a vast quantity of different medicines; but the tumours continued rather to increase in size and number, and produced a continual inconvenience to me. As the *vital air* is said to alter the character of the blood, and I conceived my case arose from a broken state of blood, I waited on Dr. Thornton, who thinking these tumours very likely to be removed by the *air*, wished me to make the trial. At that time several of the tumours were commencing, others were upon the point of breaking, and others again were in a state of open sore. My bowels were first cleared, and I inhaled the *vital air*, and took bark twice a day in powder. The effect the *air* had on me was, as my mother and sister observed, to make me eat more than usual. I felt uncommon spirits, and no longer complained of chilliness. The tumours that were in their first state disappeared; the others looked redder and gave me more pain, and discharged matter. But in a fortnight these also yielded to the air and disappeared, and I was cured. But what surprised me most was the change it produced in my eye-sight. My eyes for the space of fifteen years had been uncommonly weak; so weak, that I was never able to read or write by candle-light, but from inhaling the *vital air*, they have acquired such strength, that latterly I have sat up writing in my books, sometimes from twelve to one o'clock, without feeling my sight the least fatigued. My mother used to attribute my weakness of sight to my having had the measles very bad. I am at the present time perfectly well, and without any fear of my former afflicting disorder.

I am, Sir,

With the greatest respect, &c.

HENRY FREDERICK COOPER.

IX. HYDROTHORAX, OR DROPSY OF THE CHEST.

Case 16.—*Sir William Chambers, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page* 3.

Having been informed, says Dr. Beddoes, that Sir Wm. Chambers, when labouring under the pressure of unspeakable distress, had derived more than present relief from *oxygen air*, I requested from him an account of the effects he had experienced from it, and received the following letter:—

Letter from Sir William Chambers, Knight of the Polar Star, F.A.S. &c. &c. to Dr. Beddoes.

Upper Norton-street, June 20, 1795.

SIR,

As every person of a benevolent mind and enlarged understanding must approve of the design of those gentlemen who are endeavouring, from a philosophic induction, to introduce aerial remedies for the removal of otherwise incurable diseases; and as my case appears such as to demonstrate the efficacy of the *vital air* in a disorder that has hitherto resisted the ablest practitioners in physic, I will attempt, as far as lies in my power, to describe my situation, and the effects which I experienced from this new remedy, and shall be truly happy should the same advantages be felt by others under similar circumstances.

Previous to my coming under Dr. Thornton's care, every means which extensive experience and great abilities could suggest, had been tried by my friend Dr. Turton. My complaint seemed to be of such a nature as to baffle all the powers of art. I was at that time hardly able to move from one chair to another. It was with the utmost difficulty I could get up stairs. I had water in both my lower extremities, and great oppression on my breath, so that when I lay down to sleep, I was frequently obliged to start up and resume an upright posture, to prevent myself from being, as it were, suffocated. My nights were bad, my appetite gone, and for months I had not been able to swallow any thing solid. Indeed I had given myself up as a lost man, until I heard of the *vital air*, which my friends told me had done such extraordinary things in medicine and surgery. I conceived that as the application was to the seat of the disease, it promised more than most other remedies, and accordingly, about ten months back, I began the inhalation of this air. Dr. Thornton approved of the plan of medicine I was pursuing, which was bitters to strengthen the system, and as occasion might require, a warm laxative pill; these were therefore continued. After a few weeks trial of this new mode of treatment by the *vital air*, the above medicines being continued, my strength was so far recruited, that from my own reckoning, I could walk upwards of two miles; my ancles did not pit; my breathing was relieved; my appetite improved; and my countenance so much mended, that all my friends, together with my physician, congratulated me on my recovery. I was able to pay my respects to his Majesty, who complimented me much on my good looks, and made many inquiries respecting the *vital air*. I was enabled regularly to attend the Board of Works and the Royal Academy. But I had to battle through such a winter as few, at my time of life, have been able to support. The influenza, which was general, was a great drawback to my full restoration, as the *vital air* was obliged to be desisted from at that time, and recourse was had to evacuants, cooling medicines, blisters, cupping, and a low diet. But this, together with several colds that have occasionally attacked me, has in my mind, only manifested the more the efficacy of the *vital air* in my complaint; for as soon as it has been judged prudent to have again recourse to the *vital air*, the symptoms that had gained ground during the intermission, have been as constantly subdued, and my friend Dr. Turton has told me, "that I could not do better than "to go back to the *vital air*," to which I do not hesitate to ascribe my present freedom from oppressive respiration; comfortable nights; clean ancles; power of eating solids with appetite; and, in a few words, as much return of health, as a person at my time of life, 75, has reason to expect after such an attack, and I think abundantly sufficient to be thankful for, and to prove the virtue of the *vital air*, in all complaints of this nature; but this I must leave to you, Dr. Thornton, and others to determine, to whom I sincerely wish every success in their laudable attempts to lessen the afflictions of mankind;

And have the honour to be,
Dear Sir,
Your obedient humble servant,
William Chambers.

X. ASTHMA.

Case 17.—*James Hare, Esq. M.P. under Dr. Beddoes, cured. Vide Dr. Beddoes' Considerations, Part IV. page* 49.—*Letter from James Hare, Esq. M.P. to Dr. Beddoes.*

Sir,

I very willingly consent to your publishing my case, in hopes that other persons may obtain relief from a similar treatment. For near *eleven* years I have been subject to frequent attacks of nervous asthma, under which I suffered inexpressibly. Blisters on the chest, with expectorant medicines, usually relieved me, though not till after many hours of agony. I was troubled with this disorder more in damp than in frosty weather. If I caught cold, I scarcely ever escaped it. My strength and spirits were very much affected for a long time after the difficulty of breathing had left me. About the middle of September last, (1795) I began to take *oxygen air*, by the advice and under the direction of Dr. Beddoes. In a few weeks there was a sensible and visible improvement in my general health. Towards the end of October I caught cold, and had a pretty severe fit of asthma, though much less so than many former ones. From that time to the present, I have only had five attacks, all slight in degree and short in duration. For many years past I have suffered much from illness in the spring: but this spring I have not been confined for one hour; and, during the whole ten months I have enjoyed a much better state of health than for many preceding years. Hot rooms and damp weather affect me much less than formerly; and I have caught cold several times without its bringing on an asthmatic fit. Having taken the *oxygen air* once a day (with few interruptions) for about nine months, the beginning of this month I discontinued it; in full hopes that I may go through the summer without its aid, and so reserve it for future exigencies.

J. HARE.

Conduit-street, July 29, 1796.

Case 18.—*Miss Sarah Green, under Dr. Beddoes, cured. Vide Dr. Beddoes' Considerations, Part IV. page* 59.

Dr. Beddoes, in his Considerations, says he has before him two letters from Francis Green, Esq. of Denmark-Hill, Camberwell, respecting one of his daughters, aged 18, who had been for several years violently afflicted with spasmodic asthma. The letters are dictated by that warmth of kindness, which an affectionate parent feels towards those whom he considers as having been instrumental in rescuing his child from an obstinate and most violent disorder. The following are the facts stated by Mr. Green. The paroxysms, before the patient's arrival at Bristol Hot-wells, in October, 1795, had "come on periodically once a week. "There she grew much worse, until some short time after "I had the pleasure of consulting you. I must acknow-"ledge the *vital air* has done wonders in her case." This letter is dated September 14, 1796. The essential part of the 2d letter runs as follows:

Brighton, September 17, 1796.

SIR,

My dear daughter, as well as my whole family, have every thing to thank you for. The morning we left Clifton, turned out very bad. We had wind and rain nearly all the way to Oxford; what increased our fears most was, we lost the air from the air-holder, it being unsoldered. We spent the next day there, and although the weather continued very indifferent, to my great surprise my daughter remained well. The day following we reached home, and waited with anxiety for the apparatus, fearful of the return of the complaint, but to our great joy I assure you she has not had a fit since. We have now continued the use of the air for near ten months, and about two months back took her to Brighton by way of trial, but the second day after our arrival, (the weather was very changeable) perceiving a weakness in her eyes, which I have always considered as a symtom of the old complaint, we returned immediately to our house in Camberwell, where after staying a short time, the weather coming on fine, we came again to this place for another trial, and have the satisfaction to say she has continued well without the use of the *oxygen air.*

I am, dear Sir, &c.

FRANCIS GREEN.

Observations by Dr. Beddoes.

The two preceding cases came under my own observation. They were among the worst in their kind; and the event, as far as we can perceive at present, has been eminently successful. Mr. Hare and Miss Sarah Green I saw every day for three or four weeks. Their fits were very frequent and severe; but they were in other respects such as are commonly to be observed in spasmodic asthma. I do not therefore think it necessary to enter into any discussion concerning the symptoms. But there are a few facts which it would be unfair if I were to conceal from the reader. Mr. Hare began with one quart of *oxygen air* to about twenty of atmospheric, twice a-day—he never exceeded three quarts of *oxygen* at one dose. The morning after the sixth dose he observed some streaks of blood on a small quantity of mucus, which he had expectorated. This did not alarm him, nor to the present day, (Sept. 23, 1796, on which I have seen Mr. H. in excellent health) has it been followed by any suspicious symptom. From my idea of the stimulating power of *oxygen gas,* I felt some alarm, and persuaded my patient to desist from the use of the *air* for a day or two; and at this moment I believe that I should have advised the entire discontinuance of it; but Mr. H. who laid no stress upon the occurrence, was little disposed even to procrastination; and he expressed a firm resolution to run some risk in order to procure an abatement of his harassing complaint. He accordingly went on respiring diluted *oxygen* till the time specified in his letter, since which he has not resumed it. Like many other asthmatics he was particularly liable to catarrh; in consequence of which he never failed to have a paroxysm. Apprehending he had taken cold once or twice during the first fortnight, I ordered him four or five grains of antimonial powder at bed-time. Dr. Thornton*, in consideration of his weakened habit, had before suggested to him the propriety of taking tonic medicines. I did not scruple to order pills of equal parts of extract of gentian and sulphate of iron (green vitriol), of which, after leaving Clifton, Mr. H. took five or six grains a day for some time. For this twelve-month past he has not taken an atom of any opiate or antispasmodic medicine. The apparent improvement of this gentleman's constitution is, in my opinion, still more remarkable than the diminished frequency and force of his disorder. *Oxygen air* has frequently enabled persons to bear cold better; and I have met with no one who seems to have experienced this agreeable change to a greater degree than Mr. Hare. When I was called to Miss S. Green, I found her labouring under an attack of asthma, which with some small remissions, continued three days and nights. Her fits had been of late so severe as to give her friends the idea of immediate danger. Having had a very slight return of her disorder, from cold, she was placed under the care of Dr. Thornton, who pursued the same plan; and upon any relapse, the *vital air* has been had recourse to with success, and she now enjoys an excellent state of health.

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* Dr. Turton recommended Mr. Hare to Dr. Thornton, who advised this gentleman, as it was hot weather, to leave London, and inhale the *oxygen air* under his fellow colleague Dr. Beddoes, as he did also Miss S. Green.

Case 19.—*Boothby Clopton, Esq. under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 21.—Mr. Boothby Clopton's replies to Queries respecting his personal experience of the inhalation of vital air.—Letter to Dr. Beddoes from Dr. Thornton.*

London, July 19, 1795.

It is with great pleasure I send you the enclosed letter proposing queries to Mr. Boothby Clopton.

Dr. Thornton's letter to Mr. Clopton.

Sir,

As Sir William Chambers, and several ladies and gentlemen of character in England, have consented to authenticate the effects of the *vital* and other *aerial remedies* on themselves, and as my motive for this application is no other than the extension of the most important of the sciences, I am emboldened to request the same favour of you. You, Sir, are so well known to move in the highest circle of life, that your testimony will greatly contribute to draw attention towards an investigation, which I have no doubt will *finally* be productive of much general good. Permit me then to request your answer to the following queries.

1. What was the nature of your indisposition?

Ans. Asthma, accompanied with great debility.

2. How long had you been ill previous to your coming under my care?

Ans. Seven months.

3. Did the gentleman who attended you, make any objection to your trying the *vital air*, or did he suppose other medicines would have had equal efficacy?

Ans. Sir Walter Farquhar had no objection, medicines having been so long used without the smallest benefit.

4. Was the disease after a time alleviated?

Ans. Immediately on my inhaling the air, I was less oppressed with asthma, and slept better the first night than I had done for seven months.

5. Did you find any alteration in your strength and spirits?

Ans. My strength and spirits were certainly increased.

6. Did your friends observe any alteration in your countenance?

Ans. Not only in my countenance, but in my person, for my nights being rendered good, I encreased considerably in weight.

7. Has the advantage been permanent?

Ans. I inhaled the *vital air* in the winter, and am now in perfect health; and as I took no medicine, I am convinced my recovery proceeds solely from inhaling the *vital air.*

Case 20.—*Rev. Dr. B——, under Dr. Thornton, cured. Vide the Rev. Mr. Townsend's Elements of Therapeutics, Vol.* I. *page* 398.

The Rev. Dr. B——, an intimate friend of the celebrated oculist Mr. Wathen, had for more than two years been afflicted with asthma. The paroxysms were singularly severe, so that he could not breathe but in a contorted position of his body; they recurred regularly each night, and lasted in general from five to seven hours. Being quite exhausted, he would at length fall asleep, but awoke with a parched tongue and very languid.

He had been under the care of several very eminent physicians, and latterly under Dr. Warren, who told him, with his accustomed liberality, that he was persuaded, from a very extensive experience, that asthma, when once fixed in the habit, was not to be removed by art, however it might be palliated, and he must not therefore entertain the fallacious hope of a cure from medicine, and fly from physician to physician, but must patiently resign himself to the affliction. But daily losing flesh and strength, his family began to be very apprehensive, and Mr. Wathen having told them of the extraordinary relief and final cure, obtained by a young lady of his acquaintance, in the most violent spasmodic attacks*, when the prescriptions of the ablest physicians could render her no service, and that an asthma even of forty years standing bad been greatly relieved by the inhalation of the *vital air*, this gentleman was encouraged to confide himself to the care of Dr. Thornton.

In ten days time, by cleansing the stomach of viscid mucus, and restoring the vital principle to the blood, his paroxysms were somewhat less violent; after which, by strengthening the system, and still continuing the inhalation of an *oxygenated atmosphere*, he had several intermissions, and in two months he was perfectly free from asthma.

He continued throughout the whole of last winter perfectly well, and at the present time is, as Mr. Wathen informs me, in the full enjoyment of the blessing of health.

Case 21.—*Mr. Stepney's two servants, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. p. 50.—A letter from Mr. Phipps, Surgeon and Oculist in Ordinary to his Majesty, to Dr. Beddoes.*

Pall Mall, August 8, 1796.

SIR,

Mr. Stepney having mentioned to me that a servant who attended him had been afflicted with a spasmodic asthma above thirty years, I recommended Mr. S. to place him under the care of Dr. Thornton. Accordingly he did so. He was ordered a more generous mode of living; and whenever his disease has threatened an approach, it has been invariably put off by the inhalation of *vital air.* During the last eight months, he has had but two paroxysms, which were so slight as not to confine him to his bed, as formerly: and I should add that his *son*, who, upwards of seven years, had constant dyspnœa, with frequent spasmodic attacks of asthma, was also cured four months ago by the same remedy in seven days, and when I saw him lately he was blooming, and in perfect health.

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* Vide Case XXVII.

I remain, Sir, &c.

J. W. Phipps.

Case 22.—*Mrs. Barrett, under Dr. Thornton, cured. Vide Dr. Beddoes's Considerations, Part III. page 26.—A letter from Mrs. Barrett to Dr. Beddoes.*

Queen-square, Westminster, July 12, 1795.

Sir,

My asthma had afflicted me three years. It attacked me very violently at times, the fit going off generally with expectoration, leaving me very low and weak. The last winter it was uncommonly severe, and latterly, for months, I had not known what it was to enjoy a comfortable night's rest. As a tradesman in our neighbourhood had been just cured by Dr. Thornton, by means of *vital air*, of an asthma of thirteen years standing, I resolved to put myself under that physician's care, though before this, I had made up my mind to try no more medicines. I inhaled the *vital air* from a large bell glass, and its effect was so immediate, that on the second night I slept the whole night through. My attacks were now less frequent, and milder, and pursuing the *vital air* for six weeks, I got free of my complaint. With the blessing of God, I have continued since in perfect health, except I catch a bad cold, when my asthma recurs, but then in a very slight degree.

I am, Sir,

Your obedient humble servant,

ELIZ. BARRETT.

Observation on this Case by Dr. Thornton.

The tradesman, whom Mrs. Barrett mentions in her letter, is a baker in Tothil-street. He certainly obtained considerable benefit, and when I sent on the 20th of July, 1795, to enquire how he continued; the answer returned was, " that he had not enjoyed such health, as at present, for years."

XI. DISPNŒA, OR DIFFICULT BREATHING.

Case 23.—*Mrs. M——, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 29.—Letter from Mr. Phipps, Surgeon and Oculist in ordinary to the King, to Dr. Beddoes.*

Pall-Mall, Aug. 5, 1795.

SIR,

Understanding that you are collecting accounts of the various effects either seen or felt from the *vital air*, I embrace the present opportunity of transmitting the result of two cases which came under my particular notice. I was first induced to recommend the *vital air*, from observing the very happy and immediate effect it had in removing violent spasms, which had resisted, in a relation of mine, all medicines for above three years*. Soon after, a very corpulent lady, of about 60 years of age, applied to me for a chronic inflammation in her eyes: besides which, I found she laboured under the greatest possible difficulty in breathing. She could not even walk from the coach into the house, without stopping more than once to recover her breath. After ordering what appeared to me necessary for her ophthalmia, I recommended her to the care of Dr. Thornton for her dyspnœa, requesting to see her in a week. In this short space of time the amendment greatly exceeded my expectations. She had walked above a mile to my house; her respiration had become almost free; and her nights better than she had enjoyed for a long time. She continued the use of the *oxygen air* for a month, and was most perfectly cured, and has never had any relapse.

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* Vide Case XXVII.

I remain, Sir,
Your obedient servant,
J. W. Phipps.

Case 24.—*Mr. Colvin, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page 63.—Letter to Dr. Beddoes.*

London, July 2, 1796.

Dear Sir,

The subject of this report is a very corpulent gentleman, who had been afflicted, more or less, with dyspnœa for twenty years, and under different physicians with little or no alleviation of his complaint. Mr. Colvin had commonly but small appetite; was troubled with dyspepsia; and of a costive habit of body. Upon coming up stairs he was accustomed, as he gave at first evident demonstration, greatly to puff and blow; having, as he expressed himself, no wind. He was troubled with lowness of spirits; his body was distended; and his nights were so disturbed, that he seldom slept three hours together. After he had been under my care but a fortnight, he came with his partner, Mr. Lowndes, a liquor-merchant at Temple-Bar, who assured me, that he thought Mr. Colvin was better than he had seen him these last eighteen years. Having inhaled six quarts of *vital air* mixed with thirty of atmospheric, he felt, as was ever afterwards the case, the easiest respiration, a genial glow with perspiration; vigour and lightsomeness; or in a word, for these are his own expressions, the sensation of indescribable health. Upon asking him, whether he perceived he was stronger? in an energetic tone of voice, he declared, "he felt five times as strong;" he added also, that his appetite was returned; and his sleep was undisturbed and continued throughout the night. He then went down stairs in the presence of Mr. Lowndes and Mr. Curtis, the son of an eminent surgeon at Chiswick, and having come quickly up stairs, he was able freely to discourse immediately, which Mr. Lowndes declared he had not done for years.

Case 25.—*Rev. Mr. F——, under Dr. Beddoes, relieved. Vide Dr. Beddoes' Considerations, Part I. page* 80.

This gentleman, when at Bristol Hot-wells, being much troubled with dyspnœa and mucous expectoration, used to assure me, that after inhaling diluted *oxygen air*, he could walk up the steep hill to Clifton, with much greater ease than at other times. He made the experiment innumerable times. This air, however, rendered him no permanent benefit, his disorder depending upon mal-confirmation.

Case 26.—*Mr. Yonge's experiment. Vide Dr. Beddoes' Considerations, Part III. p.* 30.

August 27, 1795.

I tried, by way of experiment, how long I could retain one inspiration of common atmospheric air, with a stop-watch before me, and found it to be 20 seconds. I then inhaled common air mixed with nearly an equal part of *oxygen air*, which I suppose enabled me to retain it 32 seconds. Lastly, I inhaled *oxygen air*, such as manganese yields. This was retained, by nearly the same effort, 55 seconds.

GUSTAVUS YONGE.

XII. SPASMI, SPASMS.

Case 27.—*Miss S——, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page* 51.—*Letter from Mr. Phipps, Surgeon and Oculist in ordinary to his Majesty, to Dr. Beddoes.*

Pall-Mall, August 8, 1796.

DEAR SIR,

I have just received a letter containing a request of yours, that I would send a particular account of the case of a young lady who had been cured of violent spasms, by means of *oxygen air*. I heartily wish it were in my power to do it with more minuteness, but I kept no journal of the case. The lady had for nearly *three* years prior to her inhaling the *oxygen*, been afflicted with spasms in her side, and indeed, through the whole extent of the diaphragm, which appeared to me the immediate seat of the complaint. For the first two years they were not constant, and only slight, very bearable, and easily removed by a few drops of laudanum. During the last year, they encreased to a degree truly terrific. She was now never totally free from pain; and generally morning and evening, the spasms became so *dreadful*, that I cannot find words to convey an idea of them. They would continue half an hour, one, two, three, and even six and eight hours. Laudanum, to the quantity of three hundred drops, produced no other effect than to render her perfectly delirious. Her breath was also at this time so much affected, that she could not go up or down stairs without resting every two or three steps, and panting to a degree that was frightful. In this state (during the spasm) she first breathed *oxygen air* by the direction of Dr. Thornton, in the proportion of about three pints to twelve or fourteen of atmospheric air, and it almost *instantaneously* removed the spasm. This same effect was generally obtained, and there were two and three days sometimes together during which she had no strong spasm: nor do I think, after the first week of inhaling the *oxygen air*, they ever returned with the same degree of violence. I found it necessary, however, to encrease the quantity of *oxygen* to about six pints with the same proportion of atmospheric air. Thus I gave it constantly at the commencement of the spasm, and always with effect; sometimes complete, and sometimes only so far successful as to render the spasm tolerable. After about three months there was a considerable amendment, the spasms were slight and less frequent. She soon after married, and had not the least return for a year and a half; at the end of that period she had some spasmodic attacks, but they were slight, and of short duration: since (this is two years since) she has been perfectly well. These, I believe, are the leading features of the case, and I only wish I could have transmitted them to you with greater particularity. I have this morning seen the lad I mentioned in my last, as cured of asthma, he has had no return whatever, and it is now more than three months since he left off the *vital air*, which he inhaled for six weeks. I have only to add, that

I have the honour to be,
Your's, &c.
J. W. Phipps.

XIII. DYSPEPSIA, OR WEAKNESS OF THE STOMACH.

Case 28.—*Mr. Cotterel, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page* 65.—*Letter from Mr. Cotterel to Dr. Beddoes.*

King-street, Westminster, Dec. 3, 1795.

Sir,

I was troubled with great flatulence, heartburn, want of relish to my food, lowness of spirits, coldness of the hands and feet, and had slept very ill for more than five years. Before this time I enjoyed very good health; and to be employed in my occupation for my wife and family was a delight, but now it was attended with extreme uneasiness to myself. I was under the care of Dr. Lister, Dr. Pitcairne, and other medical gentlemen of the first eminence. I had taken a great load of bark and other medicines, and during these five years I changed first from one physician and then to another, and tried what different friends recommended, but in the end I only grew worse. Having consulted Dr. Thornton, he gave me some hopes, and by his direction I inhaled the *vital air*, and drank three times a day water impregnated with fixed air, in which I dropt thirty drops of æther three times a day. In a fortnight I was free from my complaint, but I continued for some time the water impregnated with the fixed air, in which some salt of steel had been dissolved, and I have since occasionally chewed a warm aromatic root, and for these last two years have enjoyed very good health.

I am, Sir, &c.

Matthew Cotterel.

Case 29.—*Mrs. Broomhall, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page* 66.—*Letter from Mrs. Broomhall to Dr. Beddoes.*

Stanhope-street, Jan. 1, 1795.

SIR,

December 5, 1793, when I came under Dr. Thornton's care, I had a bad digestion, and a nervous headache so intolerable, to which I had been subject above three years, that I believe, had I not been cured, I must have lost my senses. I inhaled the *vital air*, and by Dr. Thornton's order, I took an electuary of bark and steel, three times a day, having been first prepared for that medicine. From the first I gradually grew better, acquiring both strength and appetite, and in proportion as these improved, my head-aches were diminished. I have had no return of head-ache, or want of appetite, and enjoy at the present moment very good health.

I am, Sir, &c.

ELIZ. BROOMHALL.

Case 30.—*Mary Hodder, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page* 131.

This patient, aged 39, lives a servant to Mrs. Godfrey, No. 74, Piccadilly; has for seven years laboured under sickness at the stomach, frequent retchings, great heat and pain at the pit of the stomach, and flushings of the face after eating; drowsiness, a briny water would often flow into the mouth, emaciation, great debility, horrid dreams, often waking in excessive fright, and commonly with a dull head-ache. She would faint away after any uneasiness and fatigue, and remain for five or ten minutes like a dead person; feet and legs extremely cold, subject to flatulence, extremely costive, sight impaired; and, on account of her ill health, she was obliged to leave three places. She was turned out uncured twice from an hospital, and once from a dispensary; and had tried private practitioners without benefit. Of late the symptoms of her disorder had rather increased; when she began the inhalation of the *vital air*. In three weeks, by the power of this remedy, conjoined with emetics, cathartics, bark, and steel, she became perfectly free from sickness, appetite returned, sleep was undisturbed by frightful dreams, perspiration restored, a genial glow in the extremities, countenance became healthy, and strength so far increased, that she feels herself perfectly adequate to her present situation. The air has been left off, and the amendment continues. The quantity of air inhaled daily, was six quarts of *vital air* to thirty of atmospheric air.

Case 31.—*Mr. Page, under Dr. Thornton, cured. Vide Mr. Townsend's Elements of Therapeutics, Vol. I. page 277.*

——Page, Esq. Member for Oxford, laboured under so dreadful an irritability of the stomach, or perhaps frequent spasm of that and the adjacent parts, that upon eating, he was almost constantly seized with vomiting, which latterly became so frequent, that nothing would stay on his stomach.

In this distressing moment, Dr. Thornton was sent for. The *oxygen gas*, with a certain portion of atmospheric air, was inhaled, and the balance being made on the side of *oxygen*, Dr. Thornton requested his patient to take some sustenance, which he had not done for many hours. Mr. Page refused it at first, as he was certain it would bring on him a renewal of his distress. But being persuaded by Dr. Thornton and his apothecary, Mr. Wood, to make the trial, he was pleasantly surprised on *suddenly* experiencing the power of a new remedy, and he declared he was convinced, from the experience he had of different medicines, that no other means could have produced the same effect. He continued free from sickness as often as the *oxygen air* in a diluted form was administered, until cured.

Case 32.—*Mrs. Appleby, under Dr. Harrison and Dr. Darling, cured. Vide Philosophical Magazine, Number VIII. p.* 420.

Mrs. Appleby, wife of the Rev. William Appleby, at Wooten, Lincolnshire, laboured under dyspeptic complaints upwards of *twelve* years. Nine physicians had tried their art, but to no purpose. The disorder seemed to gain ground, and was accompanied with violent spams and a paralysis of her lower extremities. Dr. Harrison of Horncastle, who last attended her, desired she would try the *oxygenating system*; and conjointly with Dr. Darling of Glandford Bridge, it was effected in this manner. Bark and oxymuriate of potash were given, and *oxygen air* inhaled; and the change produced was so great, that to the surprise of the whole neighbourhood this lady was very soon perfectly restored.

XIV. HEPATITIS, OR AN ENLARGEMENT OF THE LIVER.

Case 33.—*Mr. W——, under Dr. Thornton, cured. Vide the Philosophical Magazine, Number XVII. page* 94.—*Communicated by Dr. Thornton.*

The butler of Colonel Ironside, who had been long resident in India, laboured for several years under a well-marked liver complaint. He had been under the care of Dr. Warren, and other physicians, without experiencing any essential advantage. Colonel Ironside, as all other means had been ineffectual, wished him to try the *vital air*. He accordingly came under my care, and the same tonics were employed as he had before taken; therefore I ascribe the cure to the *vital air*, which was conjoined with these, and which soon completely restored him to health, and he has continued well now above a twelvemonth.

Observations by Dr. Thornton.

When animals placed in pure *vital air* were destroyed by so powerful a stimulus, Dr. Beddoes found the liver not liver-coloured, but of a florid red. We therefore can easily suppose it to affect this organ when given in a moderate way: and as the oxyds of mercury and the nitrous acid, which are the best remedies for this disease, act chiefly from their contained *oxygen*, it is probable that the *vital air*, will hereafter be found a specific in this complaint, possessing superior advantages over both these remedies, and will supersede them, although it cannot be put up into two-ounce phials, the principal objection raised against it; for the *airs* can now (which originated from my suggestion) be confined in barrels, and bottled off as easily as wine; and I must observe, that this patient had a barrel of *vital air*, containing 24 gallons, which cost him one guinea, conveyed for him to his master's seat in the country, and a tin pneumatic apparatus for inhaling the medicinal air, which stood him at the low rate of thirty shillings; which improvements, I trust, will greatly facilitate the general application of pneumatic medicine, when it will be sure to find that rank its merits entitle it to.

XV. ASCITES, OR DROPSY OF THE ABDOMEN.

Case 34.—*Sarah Kimber, under Dr. Thornton, cured. Vide Townsend's Elements of Therapeutics, Vol. II. page* 274.

Sarah Kimber, aged eight years, living at No. 10, Wood-street, Spa-place, Clerkenwell, with the usual symptoms of dropsy, had her belly very much distended, and upon pressure there was an evident fluctuation of water. This disorder had subsisted more than two years, and, notwithstanding the use of a variety of remedies, it went on constantly increasing till her physician (Dr. Myers) gave up all hopes of her surviving many days; in this stage of the disease, my able friend Dr. Thornton was consulted. He began with an emetic, and the subsequent day he gave a brisk cathartic of rhubarb with a neutral salt. He applied a tight bandage of flannel about the abdomen, and ordered the strong mercurial ointment to be rubbed in each evening. He put her upon milk diet, with onions and toasted bread for supper. In a few days the emetic was repeated, and when the mouth became sore, she had for two mornings brisk saline cathartics. He then gave bark and myrrh in port wine twice a day, assisted in their operation by the inhalation of *vital air.* These powerful tonics were accompanied with swinging until nausea or sickness was produced, and at night she took half a grain of opium. At the end of only ten days, in consequence of this mode of treatment, the belly was diminished more than one half, her spirits revived, and her friends remarked of her, that " she skipped about the house as brisk as a bee." After fifteen days, emetics at intervals, with saline cathartics, and the mercurial ointment, were repeated; the opium pill at night, and the tight bandage were still continued. Chalybeates were then thrown in, and the emetics with cathartics were employed at more distant intervals, in consequence of which her complexion assumed the rosy blush of health; she was now able to vie with her companions in running, and the recurrence of the disease was prevented.

XVI. CHLOROSIS, OR WANT OF FEMALE RELIEF.

Case 35.—*Miss S——, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III.—Letter from Mrs. Stephens to Dr. Beddoes.*

Snow-Hill, August 6, 1795.

Sir,

A young lady, an acquaintance of mine, aged 20, having been two years ill, and under Dr. Carr, an eminent physician, at Northampton; but continuing in the same state, was sent on a visit to me, in order that she might obtain the opinion of some physician in London. Having had the pleasure to see the greatest benefit derived by the daughter of Sir W. D. whose case was somewhat similar, from the inhalation of the *vital air*, I was very anxious for her to make trial of the same means. The countenance of Miss S—— was pale in the extreme; her lips very white; her breathing short; she was incapable of the smallest exercise; so wearied was she in dressing herself, that even during this trifling exertion, she was obliged repeatedly to lie down; her appetite was very indifferent; her spirits low; she constantly complained of cold; and towards evening her legs used to swell. When we first went to Dr. Thornton's we were obliged to take a coach there and back, and even the getting out and in, and going up stairs, seemed too much for her. At the end of five days, the change in her strength was so great, that she was able to walk back near a mile and half: and in getting up stairs, instead of panting for breath at every four or five steps, she could ascend the whole flight with the greatest speed and ease. Her appetite was good; her spirits raised; her countenance shewed the signs of returning health; and her lips, cheeks, and nails, assumed a faint blush, which continued increasing, until she was in every particular restored to perfect health, and could walk to and back from Dr. Thornton's, above three miles, with the utmost ease, when Miss S——, after staying with me five weeks, returned to her friends, every one was *astonished* at the great alteration, and indeed she hardly appeared the same person.

I am, Sir,
Your obedient humble Servant,
CAROLINE STEPHENS.

Observations on this Case by Dr. Thornton.

1. Did not the pallid countenance; the white lip and tongue; the dyspnœa when in action; the semipellucid and polished skin; the want of perspiration; the black and pearly eye; the coldness of the frame; the dyspepsia; the yellow appearance of the teeth; the lowness of spirits; the weak and quick pulse; denote a deficiency of oxygen in the system?

2. If the skin was torn (before the system was oxygenated) there would ooze from the scratch, not blood, but a yellow serum. Is not the predominance of this fluid, the cause of that sallowness of the countenance so frequently mistaken for a disease of the liver, whence these persons have the name of bilious?

Case 36.—*Miss Lambert under Dr. Alderson, cured. Vide Dr. Beddoes' Considerations, Part III. page 57.—Letter from Dr. Alderson, to Dr. Beddoes.*

Hull, June 26, 1795.

DEAR SIR,

I was in 1793 called to meet Dr. B——, in the case of Miss L——, aged 17, who had been long labouring under chlorosis. As my colleague had been for some time administering a variety of very proper tonics, and being at that time persuaded that some preparation of steel would effect a cure, I advised only a different preparation of that mineral; but the change not producing the desired effect, a friend wished some blood to be drawn from the arm, in the hopes that after the evacuation the tonics would have a better effect.—The blood was remarkably pale, and afforded but very little crassamentum indeed ; no alteration took place in the system for the better ; she then went to sea, and returned from her voyage somewhat better ; but soon after relapsed, and the complaint being now attended with great emaciation, and an uncommon throbbing in the carotids, which upon lying down was so very troublesome as to prevent her sleeping, my assistance was again called in, and having no prejudices to overcome with her very ingenious father, I immediately proposed the inhalation of *oxygen air* ; the first effect of which was to take off the throbbing of the arteries, enabling her to lie down and to get quiet sleep ; the other effects are concisely related by her father, in his letter to me, of which the enclosed is a copy.

I am, Sir,
Your obedient Servant,
J. Alderson.

Letter from Mr. Lambert to Dr. Alderson.

Hull, June 5, 1795.

Sir,

It is not necessary that I should attempt to describe after you, the nature of my daughter Elizabeth's complaint, or to enumerate the various medicines that had been administered prior to your ordering the *vital air*. I shall therefore only mention, that the immediate effect produced by this, was a considerable exhilaration of her spirits : in a few days the violent beating in her head greatly abated—the ends of her fingers began to assume their natural colour ; and, by a steady perseverance in the use of it for about three months, together with the salt of steel, from a state of the greatest debility, and an appearance the most unhealthy, she assumed her former colour, strength and vigour. With the deepest sense of my great obligation to you,

I remain, Sir,

Your very humble Servant,

GEORGE LAMBERT.

Case 37.—*Miss L——, under Dr. Emerson, cured. Vide Dr. Beddoes' Considerations, Part IV. page 66.*

Swafham, August 15, 1796.

Miss L——, 19 years of age, had a suppression of the menses for more than two years. Her countenance was pale in the extreme, lips white, appetite impaired, general sensation of coldness, and aversion to exercise. Chalybeates, with other deobstruent and aperient medicines, were directed for her;—as these had been continued for three weeks without the desired success, she inhaled on the 20th of January, 1796, a mixture of three quarts of *oxygen* and 19 quarts of atmospheric air. It was administered only once a day, and in less than a week the patient was enabled to walk nearly three miles every morning for that purpose, with great ease, which she could not do at first without much fatigue; she attended afterwards with less regularity, not more than 12 doses having been inhaled in three weeks. She was sensible of its exhilarating effects, and derived a most remarkable degree of advantage from so small a number of inhalations. Her cheeks and lips acquired the ruddy glow of health, the appetite was perfectly restored, and indolence and lassitude were succeeded by activity and spirits. She had not experienced (her own expression) so good a state of health for two or three years. She has since continued in perfect health.

R. EMERSON.

Case 38.—*Elizabeth Byworth, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page* 67.—*Letter from Dr. Thornton to Dr. Beddoes.*

London, Aug. 26, 1791.

Sir,

Elizabeth Byworth, aged 17, was in service at Mr. Long's, New-Wharf, White-Friars, when from catching cold, the natural female relief forsook her, and she became subject to frequent hysterics; her countenance was bilious; she had qualmy sickness in the morning; appetite irregular; dyspnœa upon the slightest exercise, to which she felt extremely disinclined; and so great debility that she was unable to maintain her place. To these symptoms succeeded faintings, three or four times a day; a continued disturbance in the intestinal canal; spongy gums; towards evening, chilliness; but more frequently much external heat; no perspiration; and an irregular exoneration of the bowels. Notwithstanding the methods employed, this complaint remained above three years, during which time she lived with her mother, No. 6, Water-lane, Fleet-street. In getting from thence to my house, she was above two hours, and was quite exhausted with fatigue. She continued as a patient five weeks, during which time she took two emetics, aloetic and steel pills, and she inhaled daily thirty quarts of atmospheric air, *super-oxygenated* with six quarts of *vital air*; at the end of less than four weeks she was able to walk here without fatigue in three quarters of an hour; she had no sickness at the stomach in the morning; could go up an ascent without stopping, or scarcely panting; the gums ceased to bleed; the appetite was constant; the lips were red; the pulse bold and regular, instead of being quick and thready; her natural perspiration returned; and the complexion was so ameliorated, that the change did not fail to be noticed by every one. She has since gone to live as servant in a family in Old-street, being now in every respect in perfect health, and adequate to the situation.

From, Sir, your's sincerely,

R. J. THORNTON.

XVII. HYSTERIA. HYSTERIC AFFECTION.

Case 39.—*Miss M——, under Dr. Thornton, cured. Vide Mr. Townsend's Elements of Therapeuticks, Vol. II. page* 42.

When I was in London last winter, I had the pleasure of meeting, at the house of my ingenious friend Dr. Thornton, an amiable young lady, who spoke with rapture, of the benefits she had received from the *vital air*. Since her arrival from Italy, which was two years ago, in the vicissitudes of this climate, she early experienced a considerable diminution of strength, appetite, and spirits. She took, in consequence, a vast quantity of bark, steel, and other tonics, under various physicians, but with no alleviation of the symptoms. When she became a patient to Dr. Thornton, she was so weak, as scarcely to be able to walk across the room; she was subject to hysteric fits, which occurred seldom less than three or four times each day; and the least angry word, or slightest contradiction, excited a flood of tears. Her feet were cold as ice; but after taking food, more especially if she used an acid, she had heat and flushings of the face, while the rest of the body remained nearly as cold as her extremities.

Having the greatest aversion to every kind of medicine, she made trial only of the *vital air*, except an occasional aperient draught of rhubarb and vitriolated kali in some peppermint water. In a fortnight, by the daily inhalation of *vital air* mixed with atmospheric, the hysteric fits returned no more: her appetite improved: her spirits rose; cold was less severely felt; and her strength was so far increased, that she was able, after a fortnight, to walk near a mile, to attend on Dr. Thornton. If at any time she left off for a few days the inhalation of the *vital air*, she experienced the most uncomfortable sensation of cold, and less muscular powers, with pain in her stomach; all which symptoms were removed as often as she recurred to the use of the *vital air*. She inhaled the *vital air* during the whole of the last severe winter, continued it at intervals in the spring, used the shower-bath in the summer, and in the autumn she was in excellent health.

XVIII. QUALMS OF PREGNANCY.

Case 40.—*Mrs.*——, *under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page* 115.—*Letter from Dr. Thornton to Dr. Beddoes.*

London, December 6, 1795.

DEAR SIR,

I cannot better close this year my experience respecting the effects of *vital air* than by the trial I have made of it in pregnancy. It had been before remarked, that pregnancy often arrests consumption, but to you first we are indebted for an attempt to explain the manner in which this effect is produced. Allow me to lay your ideas before the reader. " The fœtus has its blood *oxygenated* by the blood of the mother through the placenta.—During pregnancy there seems to be no provision for the reception of an unusual quantity of *oxygen*. On the contrary, in consequence of the impeded action of the diaphragm, less and less should be taken into the lungs. The dark colour of the blood; the aching of the teeth, and bleeding of the gums; the propensity to break out into sores, their dark appearance, and difficulty in healing; the dislike to animal food, and desire of acids and vegetables; also the black appearance of the areolæ of the breasts, peculiar to that period; and the sallowness of the countenance, seem to indicate a defect of *oxygen.*" In the present case, most of these symptoms were strongly marked; they were accompanied with great dyspepsia and lowness of spirits. As with those under the influence of wine (the theory of which we before had occasion to consider,) there was a great defect of appetite in the morning, with nausea and frequent inclination to vomiting. Instead of arterial, although the lady was in the vigour of life, there was venous plethora, and she complained of universal chilliness. I observed that acid fruits and vinegar were so much indulged in, as in another state of the frame must have produced great evil. This indulgence was not however previous but subsequent to the symptoms above described, and so far from augmenting, seemed rather to lessen them.—Any smell tending to putrescency would occasion a total derangement in her constitution. Salt of vinegar and acids were very reviving, and would almost instantly stay the inclination to vomiting. In this state a violent fright produced first fainting, and then violent convulsive fits; these would afterwards appear at uncertain intervals, and last from two to three hours. Wine, laudanum, peppermint, and brandy, seemed the most salutary remedies, either by being a stimulus adapted to the torpor of the system at that period; or else from the consent which this occasions with the lungs, a larger portion of *vital air* was in consequence imbibed with the blood flowing through that organ. As things were thus circumstanced, I thought of the *vital air*, and your theory authorised me to make this delicate and interesting trial. Therefore, during one of these paroxysms, peppermint-water and wine being first ineffectually administered, the room was sprinkled with vinegar, I then pressed into the lungs *super-oxygenated air*, and in a few minutes there was a most evident alteration for the better. This lady being so speedily recovered, the *super-oxygenated air* was inhaled afterwards for several days, and it seemed to bring back the frame to the natural state of health; but I chose not to persist in the use of an unknown power in so delicate a situation, unless urged by the strongest indications. The lady has since been delivered of a very fine boy.

Ever your's,

R. J. Thornton.

XIX. PARALYSIS, OR ENTIRE LOSS OF MUSCULAR POWER.

Case 41.—*Captain Hemsley, under Mr. Kentish, cured. Vide Dr. Beddoes' Considerations, Part IV. page 3.—Letter to Dr. Beddoes.*

Sir,

Captain Hemsley, ætat. 24, commanded a transport in the service of Government, which went to the West-Indies with Sir Charles Grey's expedition. The company consisted of seventeen men and boys, fourteen of whom died from the ravages of the yellow fever. In the month of June, 1795, he was attacked by the same fever; but being ordered to England, the ship was re-manned, and during his being ill of the fever, the ship sailed. As ships, by steering to the north, quickly change their climate, it produced such an effect upon him that his existence was preserved; it could hardly be termed more: the use of the lower limbs was entirely lost, and the mental faculties were so much impaired, as to make his friends despair of his recovering his powers either of body or mind. In this state he arrived in England in August, 1795, and was under the care of the faculty at Gosport for about six weeks. After ineffectually using every means recommended by them, they advised his father to take him to Bath, instead of which he put him on board a vessel, and brought him to Sunderland. In the beginning of December, 1795, his father brought him to Newcastle, to see if the use of the vapour bath would render him any service: his situation, on his arrival here, was nearly as above stated: his feet and legs were considerably swelled from extravasated lymph, and the knees contracted from the rigidity of the flexor tendons: these parts felt below the ordinary temperature of his body, and were very insensible to the touch. Mr. Abbs, with whom I have the pleasure to be connected in business, agreed with me in thinking that the vapour bath might be of use, at least in procuring a relaxation of the rigid tendons; accordingly we ordered him to use the bath three times a week: this he continued for a month, from which he found considerable relief; the swellings of the feet disappearing, and the tendons relaxing, so as to allow every species of motion; but still there was no recovery of voluntary motion, nor any additional power. We gave him calomel in small doses; but so small a quantity affected his mouth, that he received little or no benefit from its use. The bath having performed its duty, by increasing the activity of the absorbents, and restoring flexibility to the joints, not being attended with any further beneficial effects, was desisted from, and the use of tonics, both general and local, were had recourse to; partial bathing to the feet, stimulant liniments, and electricity, wine, bark, and steel; these had an apparent good effect for some days, and then their power seemed to cease; we, therefore, thought of giving the *oxygen gas.* This being mentioned to a medical friend (Dr. Ramsay), he coincided in the opinion; accordingly, on the 1st of February, 1796, he took two quarts of *oxygen*, diluted with eighteen of atmospheric air. After drawing in half a dozen inspirations, he found a glow spreading over the whole surface of the lungs, and said he felt as if going to break into a sweat upon the neck and chest. As that part of the nervous system which retained its power, seemed possessed of great mobility, might not this sensation arise from sympathy of the external with the internal surface, as we sometimes observe such consent between the stomach and the skin? The sense of heat continued for about a quarter of an hour, and he felt nothing more from this dose: it was repeated every morning, with his expressing nearly the same sensations. On the fourth morning his urine was much loaded, and deposited a copious sediment of a reddish flaky matter, resembling brick dust. Sixth day; says he thinks his legs lighter; that is, in lifting up either of his legs, which he does by putting both his hands round his thigh above the knee, he uses less exertion, therefore we hope he has more power of motion in the leg: he has for some years been subject to a scorbutic eruption upon his face, which since his taking the *air* is rather better, and appears drying with brawny scales. Eighth day, describes the sensation he feels from the circulation of the blood in his leg, which he says sometimes stops suddenly, and then rushes on again: he describes the circulation so accurately, that the internal coats of the vessels appear to give him the sensations which he expresses. Does not this plainly shew that the blood in its passage through the lungs, under the influence of a highly oxygenated atmosphere, receives an increased degree of vitality, which it slowly unfolds to the other parts of the system.

The attendants about him observe a great change in his conduct; for though a sailor, he seemed to want the fortitude that class of men are generally possessed of; nor had he that sort of jocularity, but at present his spirits are much better. Tenth day, the glow continues longer, nearly half an hour; the circulating sensation continues, and is much more frequent; his spirits increase, and he feels such a change in himself that he begins to have hopes of recovery. Fourteenth day, he gathers strength of body, and his mind partakes, from the same cause, a greater degree of energy; his memory is much more perfect, and his answers are given with such a degree of quickness, in comparison with his manner previous to the taking the *air*, that he scarce appears the same individual. Sixteenth day, the urine has ceased to deposit, and as his strength encreases, the sympathetic effect upon the skin gradually decreases; he is now enabled to *stand* with the assistance of crutches and his back supported against the wall. From being so long (seven months) accustomed to lie a-bed, and sit on low seats, when standing erect, his head swims like a man upon a precipice, unused to such situations. Eighteenth day, his strength increases in his limbs, and his vertigo not so considerable; can take a *few steps* sideways upon his crutches, and his back against the wall. Twentieth day, recovers daily; ventures a few steps from the wall upon his crutches; when his stockings are off, his toes are perceived to have a weak voluntary motion; his face continues the same, and his spirits remain good. Twenty-third day, continues to improve; can get off his chair alone, and walks about his room on crutches; expresses a great desire to be allowed to come down stairs, in which he is indulged; it is the first time since he has been here, which is between two and three months; seems highly delighted with the change, as he expresses himself, he feels he gets better every hour; the air in the same quantity (2 quarts to 18) is still continued. Twenty-eighth day, the weather being fine, he is allowed to walk in the garden: the muscular fibre, which was very much relaxed, has greatly recovered its tone, particularly the calves of the legs, which were so soft as more to resemble bags of oil than muscular fibres, are now possessed of that tension which bespeaks health and strength.—March 3d, continues to improve, except that his feet and legs are a little stuffed in an evening; as the vapour bath, previous to the use of the *air*, took away the œdema from the legs, he is to use it again.—March 6th. Since he was in the bath his legs have not been so much swelled; in every respect continues to improve; the pulse has not been mentioned in this case, though it was attended to, but in a chronic case it seemed a little necessary; it will be sufficient to remark, that at the time of beginning the use of the *oxygen*, his pulse was about 100 strokes in a minute, low, and weak; that immediately upon his taking the first dose of gas, his pulse beat from 8 to 10 strokes in a minute slower, and appeared a little more expanded; in the course of an hour or two it returned to the usual standard, with this difference, that as he gathers strength, the immediate effect is not so great, and that now the usual state of the pulse, instead of being from 100 to 110, is only from 80 to 90.—March 10. Continues to get better; can now walk for some time in the garden upon his crutch.—March 15. He now uses a great deal more exercise; complains of a numbness of the arm of the right hand. On investigation, this appears to have arisen from his remaining longer than usual upon his crutches, which were not sufficiently stuffed to prevent the compression upon the brachial nerve, and the large vessels of the arm. —March 20. From removing the cause of his numbness, the effect has ceased; continues the air, which is now increased to three quarts.—April 9. No bad symptoms arising from the continued use of the air, and as at present he appears stationary, it is thought advisable to give the same dose twice a day.—April 20. The increased dose seems to have been of considerable use; has made more progress; he can now *walk* with the assistance of *two sticks*; is in great spirits; entertains no doubt of getting well.—May 6. Is now so well, that we have advised his father, who lives by the sea, to take him home for the benefit of sea-bathing, which we have no doubt will perfectly restore him.

Extract of a letter (inclosing the preceding Case) from Mr. Kentish.

Newcastle, June 6, 1796.

SIR,

I likewise inclose a letter from my friend Dr. Ramsay, of whose attendance and advice I profited during the whole of the case. I wished his testimony as well as my own, for we are sometimes led to be too partial, where we are anxious for success. This first essay has induced the faculty of the infirmary here to order an apparatus; and as my partner (Mr. Abbs) is the senior surgeon, I shall have an opportunity of seeing its effects in surgical cases. Several, related both in the 1st, 2d, and 3d Parts of your Considerations, would induce us to hope for considerable aid from it. When I am further acquainted with the result of Captain Hemley's case, I will inform you of it, when I hope to have some more observations to communicate.

I shall hope to hear of your receipt of this; and I have the honor to be,

Sir, your obedient humble servant,

J. KENTISH.

Letter from Dr. Ramsay to Dr. Beddoes.

Newcastle-upon-Tyne, June 10, 1796

SIR,

It gives me pleasure to have an opportunity of adding my testimony to Mr. Kentish's of the efficacy of *oxygen gas*, in the case of Captain Hemsley.

I saw the patient after the fruitless administration of the remedies enumerated, and was asked whether he appeared a proper subject for a first trial of Pneumatic Medicine here. Anxious for a trial under less unfavourable circumstances, I hesitated for a while. *Hopeless*, however, as the patient's situation seemed to be, I at length approved of the attempt, as failure could not lessen my confidence in its general utility; and aware that success in this instance would to others afford proof indubitable of its efficacy. The case, as drawn up by Mr. K. presents a faithful and accurate statement of facts. The conjunction of cause and effect, that is, the administration of the remedy and amendment, has seldom appeared more distinctly in the employment of any medicine in any disease than in the present instance. The zeal which Mr. K. has uniformly shewn for the advancement of medicine, and his readiness in adopting every means that promise to promote that end, entitle him to the thanks of every friend to science.

I am, Sir,

Your very humble servant,

JOHN RAMSAY.

Case 42.—*Mr. Howison, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XVI. page* 429.—*Communicated by Dr. Thornton.*

Mr. Howison, who dissects for Mr. Cruickshank and Mr. Wilson, eminent teachers in the school of the late Dr. Hunter, had a paralytic affection of the right hand, which deprived him of its motion, and it felt to the other hand always remarkably cold. The paralysis seemed chiefly seated in the muscle of the thumb. I advised him the trial of electricity; and we observed, as well as those who accompanied him, that the electric spark did not fly with a crackling noise to the paralytic muscles. Trying a piece of dead meat, we found the same phenomenon. We then had recourse to inhalation of *vital air* mixed with atmospheric. The muscle, now receiving oxygenated blood, afterwards caught the electric spark very readily, and a genial warmth was diffused throughout the paralytic hand. This was not a solitary observation, but constantly the case, and it seems to me very forcibly to prove the animating principle derived from the oxygen of the air to the muscular fibre; a principle not, as represented by Mayow, the most subtle, spiritual, and æthereal, but one that can be made obvious to our senses in the form of air, adhering to the calces of metals, and capable now of being conceived even by the most gross understandings.

The patient, I am happy to add, by this combination of external and internal stimulants, is completely restored, and has continued now many months perfectly well.

I remain,

Your's truly,

R. J. THORNTON.

XX. ATONIA, OR EXTREME NERVOUS AND MUSCULAR DEBILITY.

Case 43.—*Mrs. Roberts, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page* 65.—*Letter from Dr. Thornton to Dr. Beddoes.*

London, July 4, 1796.

SIR,

Mrs. Roberts, aged 50, who lives at No. 43, Piccadilly, was more than twelve years ill. She had been successively under the most eminent physicians, first under Dr. Pinkston, then under Dr. Cadogan, next a full year under the celebrated Dr. Cheston of Gloucester; from him she passed under the hands of Dr. Farmer, of that city, who attended for two years, and she was next under a distinguished practitioner of Bath, and so she went from one able practitioner to another; she was at last so reduced, that she was not only confined to her room, but could scarce get from her bed to an easy chair, which was placed in it. Dr. Merryman now attended her. Her long illness had already cost her above three hundred pounds. Being called in, I premised a mild aperient, and afterwards ordered bark and lime-water, and gave Mrs. Roberts the *vital air.* At the time of inhalation this lady felt greatly relieved; the yellowness of her complexion soon wore off; she had a glow of warmth; her appetite and perspiration were established; and so sudden was the amendment, that in less than a month she was restored to perfect health, and has continued so now above three years.

I am, dear Sir, your's, ever,

R. J. THORNTON.

P. S. The quantity of *vital air* given was six quarts to thirty of atmospheric air.

Case 44.—*Mrs. Robinson, under Dr. Thornton, cured. Vide Philosophical Magazine, Number IX. page* 299.—*Letter to Dr. Thornton.*

Dulwich Common.

DEAR SIR,

I return you many thanks for your kind attentions to Mrs. R. Your method of treatment, under Providence, has certainly performed a wonderful cure. My wife had not inhaled the air three times before I perceived a very great alteration, both in regard to appetite and spirits; her strength, in a week, was also so much restored, that she could with ease walk five miles, when before it was quite a fatigue to walk one. I can with pleasure likewise add, that what alarmed us both—the coldness of her extremities, and blackness under the finger-nails—are both entirely removed, and her nails now appear healthy. As my wife has not enjoyed such good health for several years as she has experienced these last six months, Mrs. R. unites with me in grateful acknowledgements to you;

And I remain, dear Sir, your's respectfully,

M. ROBINSON.

Observations by Dr. Thornton.

This lady, residing in a country seat, which has a delightful garden, and a good deal of ground attached to it, in an open situation, could not be supposed to want *vital air* in the blood. Such, however, appeared to be the fact. In such cases I find by the eudiometer, that the blood is in fault, attracting but slowly into its bosom the vital principle. But as even the most apparently incombustible bodies readily deflagrate in pure *oxygen air*, as steel, &c. the same phenomenon might be expected in the human frame; and in the present instance we see that this was actually performed. The good, however, of a temporary inhalation of a *super-oxygenated air* would have been lost, unless the blood had been altered. Steel was therefore enjoined, together with what is styled the phlogistic regimen; and the event exactly corresponded with my expectations—the radical defect was obviated, the attractive power in the blood was improved, and the blood coming into contact with a *super-oxygenated* atmosphere, readily imbibed a large proportion of *vital air*. The blackness under the finger-nails in consequence soon disappeared, the appetite became quickened, the spirits were increased, and the blood freely passing from the centre to the circumference, and from the circumference back again to the heart, the phlogistic particles discomposing the *vital air* in the blood in its passage, hence the extremities, and the whole body, became permanently warm.

XXI. MELANCHOLIA, OR GREAT DEPRESSION OF SPIRITS.

Case 45.—*Mr. Russel, cured. Vide Mr. Townsend's Elements of Therapeutics, Vol. I. page 292.*

Mr. Russel, an engraver, who lives in Constitution Row, Gray's-Inn-lane, had been many years in so desponding a state, that latterly he could not even bear the innocent mirth of his numerous family. He was nearly incapacitated from his employment, and as he had tried bark, steel, and other tonic medicines, without benefit, he entertained but little expectation of recovery.

He had a cough in the morning, was of a very costive habit, had frequent and violent head-aches, and passed for the most part, restless nights, or, when he slept, he was troubled with frightful dreams. Being emaciated, and looking very sallow, he was conceived by every one to be in a deep decline.

Dr. Thornton, with that propriety which pervades his whole practice, gave him first an emetic, then a gentle cathartic, and after that, he united all the tonic powers to recover him; as, the inhalation of *oxygen air*, diluted with a portion of atmospheric air; bark, with a tincture of the same; and columbo root; a more generous diet; exercise; and the amusement of company. He cautioned him, for the easy passage of food (as the motion of the stomach is from left to right) always to lie on his right side.

He gave him occasionally an emetic or cathartic, and, under such judicious treatment, he was in a very short time restored to health.

A Letter from Mr. Russel to Dr. Beddoes.

Constitution-Row, Gray's-Inn Road, Aug. 1, 1795.

SIR,

The Rev. Mr. Townsend's account of my case is perfectly correct, and expressive of my situation. Wherever I go, all who know me testify the greatest surprise at seeing me so recovered. Since which time (nearly two years) I have continued in excellent health, having had no return of my former, or any other complaint.

I am, Sir,
Your obedient servant,
JOHN RUSSEL.

Observations on this Case by the Rev. Mr. Townsend.

The symptoms of melancholia are:

1. *Pulse slow, small, weak, and the balance of the sanguiferous system on the side of the veins.* See Cullen's First Lines, § 1589. This proves that the vital energy of the heart is so much diminished, as not to balance the natural elasticity of the arteries. Hence they contract more forcibly than the heart, and protrude the blood into the veins

faster than it can return. The slowness, smallness, and weakness of the pulse seem to be proportioned to the diminution of *oxygen*. When this fails, pulsation ceases; and the blood being collected wholly in the veins, the arteries are altogether empty.

2. *Respiration slow.* The respiration seems to be governed by the pulse, as I have already had occasion to explain, when stating the consent between the heart and lungs. It certainly bears proportion to the demand for *oxygen*, as may be observed in dogs, who have consumed more than their usual quantity when in pursuit of game. The more pure the air, the slower is the respiration; but in proportion as the air is vitiated, either by substances, which are destitute of *oxygen*, or by those which greedily seize it, the more laborious is the respiration. This may be proved by the breathing of some asthmatic patients, and their cure by *well oxygenated air*. This we observed in my account of a bilious autumnal fever, to which I must refer the student. Since then the respiration in melancholia is slow, it is evident that the demand in the system is small. If more were demanded, more would be supplied, and respiration would be quickened.

3. *Paleness.* This universally is a symptom of debility, and proves that the balance of the sanguiferous system is on the side of the veins, or, in other words, that the vital energy of the heart is much diminished. This may be clearly proved by the paleness of syncope and death.

4. *Perspiration* and all the *secretions* much diminished. These effects naturally follow the weakened energy of the heart, but they do not altogether depend upon that cause, for the secretions are promoted by *oxygen*, and suffer loss by its deficiency.

5. *Coldness of the extremities.* That vital heat depends on *oxygen*, is put beyond a doubt by the experiments of

Drs. Crawford, Beddoes, and Thornton, which prove that it bears proportion to the quantity of this received into the lungs. Heat, however, is not generated merely in the lungs, but throughout the system, wherever there is either muscular motion or animal secretion. The pulsation of the arteries, and the oscillatory motion of the extreme vessels, with the secretions, being, as already stated, all diminished, the vital heat must consequently be diminished to the same degree, and this diminution will be therefore most perceptible in the extremities, where the quantity of blood is least and its circulation slowest.

6. *Digestion much impaired.* This effect seems to arise from the diminution of the vital heat, for the experiments of John Hunter on various animals which sleep through the winter, it appears that the digestive process is quickened by heat, and checked, or totally suppressed, by cold. But if the student recollects what has been delivered in the first volume of my work, on respiration and digestion, he will be, I trust, inclined to think that digestion is promoted by the inspiration of *oxygen*, and impeded by vitiated air received into the lungs. Digestion, however, is not produced by either heat or *oxygen*, but by the gastric juice. We have reason, therefore, to conclude, that for want of *oxygen*, the gastric juice is either deficient in quantity, as we may be the more inclined to think, when we consider that all the secretions are diminished, or vitiated in quality, as may be readily conceived, when we reflect what changes in the whole system are produced by air and heat.

7. *Loss of appetite.* This naturally follows from the deficiency of the gastric juice. But when the appetite, instead of being impaired, is exceedingly voracious, this may arise from the stimulus of indigested sordes.

8. *Costiveness.* This likewise may be attributed to want of *oxygen*, for when Dr. Thornton, as he informs me,

made his dyspeptic patients breathe *super-oxygenated air*, they not only acquired appetite and spirits, but became more regular in their bowels. *Oxygen* increases the secretions in general, and therefore may increase the quantity of bile, which is the natural cathartic of the body, and, at the same time, giving tone and vigour to the secreting vessels, it is probable that it may improve the quality of the secreted fluids. But, independently on this, we may observe, that the perspiration being diminished, the determination is naturally increased to the internal surface, where, at the same time, the glands being much relaxed, a superabundant quantity of mucus, of viscid mucus, is collected, so as to separate between the bile and the animated fibre, and thereby prevent the operation of that natural cathartic. It is not, however, an universal symptom, or constantly present in melancholic patients.

9. *Spirits depressed.* I have already had occasion to speak of *well oxygenated air* as raising the spirits, and have related the case of Mr. Russel; but since that period we are favoured with many still more interesting cases, in which the same effect is frequently remarked. The case I chiefly refer to is, that of Mr. Atwood, communicated to Dr. Beddoes, and by him presented to the public in the second edition of his inestimable work, entitled, Considerations on the Medical Use and on the Production of Factitious Airs; printed for Johnson, in St. Paul's Church-yard. As I very often saw Mr. Atwood during the progress of his cure, I feel highly interested in his journal, where I am happy to observe the same energetic expressions, which I heard him utter, whilst he was under the care of Dr. Thornton. If then the spirits are elated by a plentiful supply of *oxygen*, are we not warranted in our conclusion, that depression of spirits may be caused by its deficiency? Should we inquire how it happens, that the lungs do not derive a proper supply

from atmospheric air, I might simply appeal to facts, leaving others to assign the cause and to account for this effect. But I shall rather make the attempt myself, and at the same time remind the student of the hints, which I ventured to throw out in the first volume of my work.

Every process in Nature seems to depend on either attraction or repulsion.

Of attraction, we distinguish various kinds; the attraction of gravitation; magnetic attraction; the attraction of electricity; and chemical attraction. But besides these we observe another, which may be called vital attraction. On this depends the growth of the living fibre.

Vegetables attract their nutriment, both by their leaves and by their roots, which in extent are proportioned to each other. Animals go in search of food; but after they have swallowed and the stomach has digested this, the lacteals make their selection, and absorb such parts as are best suited to nutrition. In them the absorbents of the alimentary canal, at the different periods of their growth, and the pulmonary air vessels bear proportion to each other, and I have already stated a relative proportion between the *oxygen* attracted by the lungs, and the quantity of food digested by the stomach.

If, therefore, the process of digestion is impeded, the attraction for *oxygen* and its separation from azot, with which it is combined or blended, according to Jacquin, in atmospheric air, will be diminished. But when the air is overcharged with *oxygen*, the quantity separated by the lungs in respiration, even in the most unfavourable circumstances, will be increased.

Thus we see in the burning of a culinary fire, when it is almost extinguished; let the atmospheric air be overcharged with *oxygen*, or give it nitre, and the effect immediately produced will be rapid combustion with vehement heat and vivid flame; or supposing the air to have only its usual proportion of *oxygen*, let more combustible matter, such as sulphur, ether, ardent spirits, or even oil, be added to the fuel, and the effect will be the same. In some cases it may be sufficient merely to blow away the dust which separates between the combustibles and *oxygens.*

These attractions and combinations are governed by the laws of relative affinity, some of which, accurately determined by the sagacious and most laborious Kirwan, he has been so fortunate as to express by numbers.

In accounting for the costiveness, I mentioned my opinion, that it might arise from viscid mucus in the alimentary canal. This cause, I am inclined to think, will at the same time prevent nutrition, and lessen, in the system, the demand for *oxygen,* and then we must not wonder that the lamp should emit a feeble light. With a plentiful supply of *oxygen* and *hydrogen*, the flame is bright; but a single drop of water floating on the surface of the melted wax, will be sufficient to cut off the communication and prevent their combination, and such appears to me the effect of viscid mucus in the alimentary canal.

From all that has been suggested, I am inclined to think with Dr. Cullen, that in melancholia there is torpor in the motion of the nervous power both with respect to sensation and volition, (See his First Lines, § 1589) ; and this, in my opinion, seems to depend on viscid mucus lining the intestines ; for no sooner is it, by a judicious treatment, cleared away, than vital heat increases, the pulse acquires strength, torpor is relieved, and the spirits rise.

This perfectly agrees with what I have stated respecting the remote causes of melancholia, all which relax the glands of the intestines, and produce accumulation of their mucus. And upon this principle, Hoffmann in melancholia approves of antimonials. *Quod si enim tenaces, viscidi et biliosi in duodeno stabulantes humores vomitu evocandi sunt, flores antimonii egregium pollicetur fructum.* Vol. iii. p. 261.

XXII. SCORBUTIC ERUPTIONS OF THE FACE, ARMS, AND BODY.

Case 46.—*Mr. Cummins, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 93.—Letter from Mr. Cummins to Dr. Beddoes.*

Islington, August 1, 1795.

SIR,

For more than two years the whole surface of my face was covered over with eruptions. To describe my real state would be as disgusting for you to hear, as it was disagreeable for me to bear. I had tried different purifiers of the blood, but the humour in my face continued the same.—Hearing that the *vital air* altered the state of the blood, about nine months ago I placed myself under Dr. Thornton's care, and began the inhalation of the *vital air*. In less than ten days I felt a very great itching, which I do not remember to have had before. The itching, however, subsided, and my face was quite cleared in about a month. This state continued four months, when I had a relapse, but it soon gave way to the *air*, and my face has continued since perfectly clear, or only here and there a pimple appears.

I am, Sir,
Your obedient servant,
JOHN CUMMINS.

Case 47.—*Elizabeth Franklin, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part V. page* 138.—*Letter to Dr. Beddoes from Dr. Thornton.*

Dear Sir,

Elizabeth Franklin, aged 19, naturally of a very strong constitution; with that want of prudence so frequently observed with those who trust too much to this circumstance, after a hard day's labour, being very dry and hot, drank a large quantity of cold water; which immediately produced so violent an head-ache, that she was obliged to go to bed. The next day there appeared an efflorescence on the skin, which soon ended in a scurfy eruption on the arms. It had progressively increased, it was now five years, and at length incapacitated her from service, and she became a burthen on her family. She had been under Mr. Dundas's care at Richmond eleven months, but without benefit; having before tried a variety of remedies. Observing the great amendment of her neighbour, Richard Major, whose case merits to be related, she was induced to apply to me. I ordered her a lotion of nitre and vinegar, which Mr. Patterson, conducted by your observations upon sea-scurvy, found to be a specific in that disease. I gave her *vital air* to inhale, as a purifier of the blood, in the proportion of six quarts to thirty of atmospheric; and I diffused a greater energy of circulation in the capillary vessels by means of myrrh, bark, and steel, having first cleared the primæ viæ. The effect of the acetum nitrosum, or solution of nitre in distilled vinegar, was the increasing of the eruption, occasioning acute pain, and rendering the parts very florid. It was, however, persisted in, and, after a fortnight, the benefit from this application became very conspicuous. The *vital air*, at the time of inhalation, always diffused a glow, increased the number of the pulse, and produced perspiration. The other remedies tended to keep up this effect; and, after a month, the arms, which before bled upon the least pressure, were in a fit state to bear the flesh brush, which has been ordered; and the surface, after six weeks, only shews the great extent and malignity of the former afflicting disorder; and the young woman is restored as an useful member to the community, being now fit for washing, and any other hard services.

Ever your's,
R. J. Thornton.

Case 48.—*Jane Finlayson, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part V. page* 141.—*Letter from Dr. Thornton to Dr. Beddoes.*

August 23, 1796.

Jane Finlayson, aged 7, living at No. 4, Carrier-street, Bloomsbury, had the small-pox five years ago; since which period she has been afflicted with a dreadful scorbutic humour, covering both legs, the shoulders, and the arms; which either encrusted, forming scales, or ouzed out a thin, serous discharge, discolouring the linen. She would often awake in the night; when, probably from extreme itching, she would tear the humour, converting it to a sight truly terrific and disgusting. This she would sometimes do, even in the day. Her mother first applied to the Gerrard-street Dispensary; and she took pills and aperient powders for six weeks, under the care of Dr. Jackson, without benefit. Her mother then took her to Mrs. Spilsbury, and she continued taking her drops for nine months; but this boasted remedy was equally ineffectual. She now went into St. George's Hospital, and fell under the care of Mr. Keate; who employed the unguentum hydrargyri nitrati outwardly, with mercurial pills every night, and an aperient powder every third morning; these were persisted in for three months; but they produced only a slight degree of benefit, in a few days after she was taken from the Hospital, the disease appeared as bad as ever. Her mother then, from a very prevalent opinion, judged her only hope was from her breathing her native air, and she accordingly took her over to Ireland; but neither the journey, voyage, nor native air, proving of service, she applied to Dr. Frazier, of Dublin, under whose care she continued six months. He employed tar ointment, and a lotion chiefly consisting of a weak lime water: but, as the case seemed to defy all art, the mother thought fit to return with her child, rather worse, than mended, seven months ago. Mr. Ogle, an apothecary in Great Russel-street, at this time refused to do any thing for her, telling her mother, " he could not be of any service, and it was best to leave her disorder to Nature." This was the candid opinion of some other gentlemen of the faculty; except that one recommended again tar ointment, and it was tried. The disorder, however, getting a-head, the poor child was for six weeks wholly incapacitated from using the slightest exercise; not being able to stand upon her legs, the humour had spread so around the knees. She was therefore brought to me in arms, and she inhaled immediately six quarts of *vital air* mixed with twenty of common air; and such is the fact, in two days' time, she was able to walk here, above a mile and a half; her spirits were elated; her complexion was cleared; the wounds had thrown off large scales, shewing a glossy red skin underneath; in a week the progress was such, that some large patches had already disappeared:—in a fortnight the humour on the legs and thighs was in many places hardened, and scurfed off:—and in three weeks, on the back and arms there remained only the signs of previous disease:—and it is now twenty days, and the legs, thighs, the back, and arms, shew a truly natural and healthy appearance. The girl took all this time three or four doses of aperients, and no other medicine.

From, dear Sir, your's ever,
R. J. THORNTON.

Letter from Dr. Babbington to Dr. Thornton.

Basinghall-street, Sept. 16, 1796.

DEAR SIR,

Mrs. Finlayson called upon me yesterday with her little girl, and brought me your letter. My recollection does not enable me, having seen the child but once, to contrast minutely the former appearance of the eruption with the subjacent parts that are now exhibited. I am satisfied, however, that there is a material alteration for the better. The inflammation, I see, has entirely subsided; there is no longer any serous discharge, which, the mother says, was at one time very abundant; and, though there is still a roughness, the superficial scaly incrustation is scarcely now to be perceived. Wishing you *equal success* in all parts of your professional pursuits, I remain,

Dear Sir,
Very sincerely your's,
WM. BABBINGTON.

XXIII. THE TRUE LEPROSY.

Case 49.—*Amaro Fernandez, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part V. p.* 147.—*Letter to Dr. Beddoes.*

London, October 30, 1796.

SIR,

Don Amaro Fernandez, aged 26, has been afflicted with leprosy above seven years. He is a native of the Canary islands, where we find that disease prevalent, chiefly among the common people, whose food consists almost entirely of salt fish, ill cured, and eaten in a state of putrid fermentation. This disease resembles much elephantiasis, differing perhaps from it only in the extent and urgency of the symptoms. It is generally deemed incurable; and terminates in rendering the unfortunate sufferer a miserable object; depriving him, by its corrosive nature, of nose, ears, palate, and eating away also other parts of the body. It increases by degrees, and sometimes gives a glimmering of hope; but the expectation always proves delusive. I will attempt to trace the dreadful progress of symptoms; and shall commence by observing, that in the year 1789, an eruption broke out on his face, arms, thighs, and legs, which appeared like purple petechiæ, and frequently terminated in offensive sores, discharging an ichorous serum. Mercury and other medicines were employed, but without effect; rather perhaps increasing the disorder. In the year 1792, these symptoms being urgent, Don Fernandez was recommended to try the Bath waters. In the letter which Dr. Scott wrote to the physician of the General Hospital at Bath, he observes, that he had tried bark, elixir of vitriol, hemlock, and that mercury had been rubbed in for three weeks, but without producing any effect on the mouth. He tried there the warm bath; and Dr. Ewart continued the mercury for two months, without its producing the smallest effect; and at length Dr. Ewart, declaring he "had used mercury enough to salivate a horse," advised him to return to London; when he beame the patient of Dr. Donavan. It would be tedious to mention all the Doctors under whose care he has been, as Drs. Myers, Relph, Babbington, &c. &c. and many of different countries; and it is impossible to record their several modes of treatment. We shall therefore hasten to the year 1795, and mention the state in which he then was. The sores appear, 1794, to have healed up, by the application of tar ointment; but the muscles at this time were in a very hardened state, and assumed a very black appearance in both extremities. Under the skin there were many hard knots, and in similar points in the corresponding extremities; and these frequently broke into fœtid and deep sores; whilst others dispersed without suppuration; and others again remained stationary. In the year 1795, the nose seems to have been first affected, and the ears, which appeared as if frost bitten, and mortifying off. At this time he was a patient of Dr. Sanderman's, and able to use exercise, notwithstanding the rigidity of the muscles. The disorder went on increasing, and he left Dr. Sanderman; and, in the year 1796, unfortunately fell into the hands of an Italian physician, who, with the most consummate folly, confined him to his bed for six months; ordered a large fire in the room, and no ventilation, and this in the heat of last summer; giving him, at the same time, his grand infallible specific for every disease, which he terms the *Phlogiston of the First Power.* He was at length so debilitated, that he was unable to sit upright in his bed. If he attempted to stand, his legs failed under him; and he had lost his appetite entirely, and hardly had power to speak.

Seeing him in this deplorable state, I mentioned to our Ambassador my wish of his trying the *vital air* under Dr. Thornton, and his Excellency obligingly complied with my desire. Don Fernandez in consequence inhaled the *vital air*, was ordered tonics, and such was the amendment, that in a week he was able to be removed from his bed to an airy situation in Chelsea. After his residence at Chelsea, and but three weeks, under this treatment, he was so invigorated as to be able to walk to and from Duke-street, Grosvenor-square. In six weeks the muscles were evidently softened; there was a less scaly eruption on the skin; and, at the end of two months, the unsound and sound parts of the nose and ears appeared united; and he is now so strong as to be able to walk from Chelsea to the Exchange, and back, without feeling the smallest fatigue; and his appetite and sleep are the same as if he had never been ill; and he is evidently much increased in bulk. The cure produced is so striking, and the trials this patient had made were so numerous, and conducted by so many able physicians, that I cannot but contemplate this as adding considerably to the reputation already so justly acquired by the pneumatic practice.

I am, dear Sir, &c.

CHARLES DE GIMBERNAT.

XXIV. ULCERS OF THE LEG.

Case 50.—*The Rev. Mr. Atwood, under Dr. Thornton and Mr. Hill, cured. Vide Dr. Beddoes' Considerations, Part I. p. 56.—Letter from Dr. Thornton to Dr. Beddoes.*

February 27, 1795.

DEAR SIR,

I am very happy to hear your proposal for a pneumatic institution meets with the support of so many eminent physicians and men of science. I wait with the utmost impatience for its establishment, firmly believing that the experience resulting from it will be of the greatest public utility. The subjoined cases will be with you a great inducement for extending *pneumatic* remedies in the proposed institution* to surgery; and they will, I trust, operate somewhat with the public in promoting a subscription sufficient for that benevolent purpose.

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* This establishment was formed, but Dr. Beddoes, instead of prosecuting the airs, was wholly taken up in trials of *Digitalis* for the cure of consumption.

The first case will appear to great advantage, as the patient has obligingly permitted me to enclose to you his journal, which is the faithful picture of his own feelings; he assures me, he had not the least knowledge of any part of your theory of the operation of *vital air*, but was induced, from seeing a somewhat similar cure performed, to confide himself to myself and Mr. Hill, an ingenious surgeon, who has been among the first to apply these new powers to the purposes of his profession.

Journal of the Rev. Mr. Atwood, Rector of Saxlingham and Sharrington.

Part I. *Statement of the Case, and of the Effect of the common Means of Cure.*

" December, 1779.—The left leg has felt for some time past very heavy; is now much swelled; upon pressure the indentation continues. This was wholly removed in about nine weeks by means of a very tight bandage on the leg, exercise, spirituous lotions, fumigations, and frictions.—October, 1780. The constitution much impaired by the hot climate of Spain; was attacked with jaundice, which yielded to slow journies on mules, and oranges.—January, 1785. Health was much deranged during this month, with great debility.—1786 and 1787. The habit much relaxed.—December, 1788. Had violent night sweats.—January, 1789. These continued to the latter end of this month.—May, 1789. Had a violent inflammatory fever.—August, 1790. Had an eruption on the surface of the body.—1791. During this whole year, experienced great debility.—March, 1792. Was seized with an inflammatory fever, attended with delirium.—May, 1792. Had a third attack. My physician ordered me sea-bathing, to remove the extreme debility which succeeded to this fever.—

From August 1792, to February 1793, bathed in the sea. During this time I had many dreadful spasms in the stomach and bowels, accompanied with nausea and vomiting. These were the forerunners of the disease, which has since affected my left leg.—January, 1793. There appeared a mahogany coloured swelling in the left ancle of the left leg, which kept up an incessant gnawing pain.—July, 1793. This hardness was attempted to be eat away with caustic; but it produced only an ulcer of a very unfavourable aspect. —September, 1793. I placed myself under a most skilful surgeon at Norwich, who applied fomentations, unguents, &c. but without any material benefit.—November, 1793. Though a cripple, was enjoined regular exercise. The ulcer, however, still continued increasing.—January, 1794. A new enemy more formidable than the other made its appearance. It had the same dark mahogany colour, and the same unconquerable hardness. By degrees this formed into a dreadful ulcer, which increased daily.—March, 1794. Came to London, and placed myself under Mr. Cruikshank, a surgeon of great eminence. Was attended by him daily with unremitting attention. Twice did he employ the lapis infernalis, but these ulcers seemed to resist every application. My constitution being extremely debilitated, with loss of appetite, want of sound sleep, and the mind exceedingly irritable, sea-bathing was once more enjoined.—From June 14, to October 18, bathed in the sea.—June 27. Mortification took place. The usual methods, bark in great quantities, port wine, and yeast poultices, were had recourse to.—October 25. Returned to London. The pains in the leg were excessive; the fœtor intolerable; the ulcers had made great encroachments; frequent nausea at the stomach; the bark and other medicines were frequently rejected, the breakfast sometimes, and now and then the dinner; the nights were excessive bad; strength impaired;

in short, every thing was unfavourable.—December. Dr. Donn, who had seen the whole progress of the case, asked my surgeon, " what prospect there was of saving the limb?" He made no reply, but very gravely shook his head.

The following letter is here introduced as essential to a complete idea of the case.

To Dr. Thornton.

Barnet, February 25, 1795.

DEAR SIR,

Being accidently present at the first interview between you, Mr. Hill, and Mr. Atwood, I cannot help expressing my great *astonishment* on finding so speedy a cure has been actually effected in so desperate a case.

The wound, I mean what particularly called my attention at the time, appeared to me to extend four inches in longitudinal direction of the muscles of the leg, and about three inches transversely. It was so deep that not only the whole thickness of the adipose membrane was destroyed, but a considerable loss of substance had taken place in the muscular parts themselves.

The ulcer was in appearance as ill-conditioned as I remember to have seen, either in the London hospital, or in my own practice of near thirty years, affording an ichorous fœtid discharge, which appeared to inflame the surrounding parts, and which must therefore have gone on increasing the evil.

The gentleman's habit of body, from his own account, was such (for he had tried bark, sea-bathing &c. without benefit) that I confess I had not the most distant idea that any cure could have been performed, much less in so short a space of time.

Indeed I think it a great happiness to mankind in general, that such a remedy as the *vital air* has been discovered, and that men of science are employing it: I am rejoiced to have such proof, that the blood and juices of our fellow-creatures can be so changed, that we need not now despair of our patients even in situations the most deplorable.

I have the honour to be, &c. &c.

JOHN CORP.

Part II. *Of Mr. Atwood's Journal, beginning the Day before the Inhalation of Vital Air.*

December 13. Got up with a peculiar sensation of weight and pain in the leg; a sense of nausea at the stomach; and no inclination for breakfast; spirits oppressed; and the mind irritable; when endeavouring to walk, felt great pain; the large ulcer in the leg looked of a blackish hue in some places; a probe being thrust into one part of the ulcer, I had not the least sensation in that part; yeast poultices were talked of; had no appetite for dinner; felt very much indisposed towards the evening; no inclination for supper; had a sense of chilliness on first getting into bed, succeeded by hot pains; passed as usual a bad night, with perturbed sleep; awoke at two o'clock with sharp and burning pains in the leg, which continued until five in the morning; dosed till nine.—December 14. Got up with nausea at the stomach, and a sense of languor; no appetite for breakfast; spirits exceedingly oppressed; for the first time inhaled the *vital air* diluted with a portion of atmospheric; had a pleasurable glow at the time; felt an appetite for dinner, and my friends observed my cheeks did not flush after dinner, as heretofore; my spirits, which were somewhat better during the day, sunk towards the evening; no inclination for supper; passed a very indifferent night.—December 15. Got up, but without a sense of nausea; had a slight inclination for breakfast; perfect ease in the leg; inhaled again the *vital air*; felt a great appetite for dinner, and a peculiar pleasurable lightness after dinner, as if no sustenance had been thrown in; with a flow of spirits; and a strange idea of being able to mount a horse, and ride as fast as people in health; appetite for supper; passed the sweetest night! such as I am sure I had not enjoyed these four years.—December 16. Got up quite refreshed, without the least sense of nausea at the stomach; a great inclination for breakfast; spirits unusually elated; took the *vital air*; felt a genial glow during the whole day; great appetite for dinner; walked with agility and without pain; the wound however appeared unfavourable to-day; appetite for supper; a good night; awoke with a thick clammy perspiration.—December 17. Spirits much depressed; no inclination for breakfast; mind very irritable; much pain in the wound; inhaled the *vital air*; the wound threw off nine sloughs this day; a slight appetite for dinner; the spirits recovered towards the evening; inclination for supper; had a sound night's rest.—December 18. Appetite for breakfast! inhaled the *vital air*; a sense of glow, which extended even to the finger's ends; the muscular powers were evidently increased; walked with slight, or no pain.—December 19. The wound for the first time discharged real pus; had the sensation, if the expression can be allowed, of perfect health, never experienced before this week; sleep very sound; pains in the leg towards morning.—December 20. Got up with great spirits; inhaled the *vital air*; the wound discharged a great quantity of real pus; a craving for dinner; felt no longer an inclination for much wine, and after four glasses, had the same satisfaction as three pints used formerly to produce; porter was now rather coveted; spirits elevated in an extraordinary degree, which, together with a genial summer's warmth, continued from four to nine in the evening, and then subsided to humble spirits; slept profoundly from ten to four, which, with the morning dose, made me get up sufficiently refreshed; transitory pains in the leg.—December 21. A fine appearance of white edges in the wounds; great appetite for dinner; an universal glow in bed, accompanied with perspiration; sharp twitching in the leg.—December 22. Appetite for breakfast; inhaled the *vital air*; the wound still kept on a great discharge of laudable pus; no appetite for dinner; in the evening a peculiar sense of weight and uneasiness in the leg; a great listlessness in the evening; much irritation in the leg, particularly in the ulcer, with much itching round the part; but an indifferent night.—December 23. Spirits oppressed; inhaled the *vital air*; returned home without much inclination for dinner; spirits rather mended towards evening; enjoyed a good night's rest.—December 24. Eat a hearty breakfast; spirits elevated; walked with ease and vigour; a surprising change for the better had evidently taken place in the wound; appetite for dinner; had a good night.—Christmas day. Still the same happy appearance in the wound to-day.—December 27. The ulcer looked wonderfully well; was evidently decreased in size; the discharge very favourable, but less in quantity; great pain was felt in the ulcer for a quarter of an hour in bed; afterwards fell into a refreshing sleep.—December 28. All the appearance of healing; the wound much decreased; some parts filled up; and the borders of a fine white; the whole leg, which before exhibited a dark purplish appearance, wore now the livery of health.—December 29. The cavity of the wound was almost filled up; the effects of the *vital air* operating together with my amendment, produced a constant gaiety, as if I had been drinking champaign; enjoyed a profound night's rest.—December 30 and 31. The same sensation of perfect health; elevated spirits; great appetite; and comfortable sleep.—New-year's day. Every thing in a good train. My toast after dinner was, "May Dr. Beddoes and Dr. Thornton, the introducers of aerial remedies, meet with that recompence from their country, which they so amply deserve."

[This toast, from motives of delicacy, I would have omitted, but I thought it my duty to transmit you the journal entire as written by the author. R. J. T.]

"It was applauded and unanimously drank.—Jan. 1, 2, 3, 4, 5, 6, 7. As on the preceding days, with evident and progressive amendment in the wound.—January 8. Went to a private concert; before, music was disgusting to me, having no spirits to enjoy it; was surprised to find myself standing, as I was playing on my violin, without leaning on a chair, at several different times during the evening, and without the least sensation of fatigue or pain.—Jan. 9. The smaller ulcer, which of late I have not much noticed, was healed.—January 10, 11, 12. Nothing peculiar.—January 13. The old ulcer was this day rubbed hard with a flannel, and the larger ulcer appeared nearly healed.—January 14. Walked with great vigour; the larger ulcer was rapidly skinning over; appetite good; spirits good; and sleep the same.—January 17. Notwithstanding the season, the most inclement I remember, the ulcer was completely skinned over: and my body seemed fortified against cold."

Here ends the journal. I have to add, that on the 25th of February, the family received a letter from Mr. Atwood, from on board the Stately, on his passage to Madras, to which he was appointed chaplain. He was then in perfect health and spirits.

Letter from Mr. Atwood to Dr. Thornton.

Symon's Town, Cape of Good Hope, 15th Sept. 1795.

My Dear Sir,

I ardently wish to enjoy the happiness of seeing you again. You have performed wonders on my peculiar constitution, formerly strong and powerful, but which was hastening to a rapid dissolution, till revived and renovated by the *oxygen air.* My strength is increasing every day with a firmness of nerve and calmness of spirits never experienced before. I persevere in an uniform plan of rising at six, walking till eight, subsisting on soup, fish, and vegetables, and going to bed at ten. Wine is left off (except three glasses of white Teneriffe wine at dinner), as well as meat. By these means I feel the habit cool and braced, with a capability of taking powerful exercise, without the least fatigue. The fleecy hosiery waistcoats you recommended are absolutely necessary in this climate, as deavy dews and cold winds at sun-set often succeed the heat of the day. The prevailing disorders of course are fevers, flux, and dysentery, which destroy many patients; except this sudden check to perspiration, the climate is delicious, but in my opinion not so hot as at Lisbon.—Last June (December here), green peas were in blossom.

With the greatest esteem,
I remain, ever gratefully your's,
T. E. Atwood.

Case 51.—*John Patterson, under Dr. Thornton and Mr. Hill, cured. Vide Dr. Beddoes' Considerations. Part I. page 65.—Communicated by Dr. Thornton.*

John Patterson, aged 45, married, has five children; he was formerly a sailor. He had endured much hardship, and at one time lived for nine months wholly on salt provisions. He was subject from the age of fourteen to eruptions on his face. When he came under Mr. Hill's care, I saw him, with a face encrusted over with humours, several purple blotches on his body, many hard scales or scurfs about his arms, and a dark-coloured deep ulcer in his leg, which gave out an ichorous and fœtid discharge. He had also lost his sight near eighteen months. These complicated evils had resisted the well-known abilities of Messrs. West, Carr, Turnbull, Wathen, Phipps, and others. This case being recommended to Mr. Hill by the last named gentleman, he gave him the *vital air*, blended with atmospheric air, as an alterative of the blood, strengthening his constitution with camomile tea and bark, and Mr. Phipps continued those applications to the eyes, which, before the purification of the blood, proved unsuccessful. After a few weeks inhalation of the modified atmosphere, I had the satisfaction of seeing him with a face perfectly clear and smooth; large white scales fell from his hands and arms; the dark purple ulcers on his body, and the varicose ulcers in his leg, were healed; and he had so far recovered his sight, that he had at first a blue, then a brighter light before him, and after a regular attendance during four months, he was able to discriminate different objects in the street.

Letter from the Rev. Mr. Townsend to Dr. Beddoes, relative to the two last Cases.

Pewsey, July 21, 1795.

DEAR SIR,

When I was in town, December 15, I called on Dr. Thornton, and finding him engaged with patients, I went into the parlour, where I met with Mr. Atwood. We soon entered into conversation, when he communicated his apprehensions of losing his leg, and asked me if I believed that the *vital air* could effect any thing in such a case. Finding this gentleman desirous of having my opinion, I explained to him, that though spirituous and other stimulating local applications might call forth, for a time, the action of a part, in which the vital energy was much diminished; yet, as exhausting it without producing action sufficient for a cure, a proportionable debility and tendency to gangrene must ensue. This, Sir, said he, is exactly my case. After every application, exciting pain, black parts have constantly appeared, which were either taken away by the knife, or else sloughed off. It is so, said I, with spontaneous mortification: it is preceded, in weak habits, by inflammation accompanied by a proportionate loss of power. But when the air is rendered by the chemist more replete with that substance, which is essential to vitality, and is inhaled by the lungs, this alters the disposition of the system, and produced what has been called the phlogistic diathesis, whereby the exhalant arteries pour forth instead of serum, coagulable lymph: the absorbents carry away diseased parts; and the lymph being rendered more tenacious, is converted into granulations. In the new mode of treatment with *vital air*, energetic action in the part is supported by the system: in the old practice it is kept up for a short time only, by partial stimuli on weak and diseased vessels. There it is produced with a change of the blood; here it deprives the blood of life: there it produces energy; here it excites irritation: there it aids the efforts of Nature, and renders them effectual; here it calls her into action, which she is unable to support. This reasoning seemed to have weight with him, and now our conversation was interrupted by a message from Mr. Hill, that he was ready to attend his patient. However, I begged permission of Mr. Atwood to see his wounds, which emitted a very offensive fœtor, and had discoloured his stocking. But no sooner were the applications taken off, than the fœtor became intolerable, and the sight so disgusting, that I was constrained to to hasten into the open air. On my return to London, January 15, I was impatient to know what had been the issue, and gave Mr. Atwood the meeting as before. The lesser of the wounds was healed, and bore the friction of a brush. The larger wound, so well described by Mr. Corp, (Second Edition of Considerations, Part II. page 55); was filled and covered with skin, excepting one place the size of my nail, which he told me was occasioned by some accident.

I was equally pleased this day with having a sight of Patterson, whose case is so well described by Dr. Thornton, (Considerations, Part II. page 57). His leg, now healed, shewed what had been the extent of his former ulcers, which were not fewer than fourteen or fifteen; his face was clear, and when I put a little bit of paper on the ground, he saw well enough to go and pick it up.

I am, Sir, &c.

JOS. TOWNSEND.

Case 52.—*Mrs. Munt, under Dr. Thornton and Mr. Hill, cured. Vide Dr. Beddoes' Considerations, Part I. page 66.—Communicated by Dr. Thornton.*

The subject of the next case is a widow lady. She had a humour in her right leg, which deprived her of exercise, and had produced a painful and discoloured sore in that part of about 18 years' standing; four years of which time she was attended by Pott, and twenty-seven months by Sharp; but neither of these eminent surgeons were able to effect a cure. After only three weeks' inhalation of the *vital air*, a violent itching came on, and in another week this leg was rendered as sound as the other. Mr. Sharp saw this patient at Mr. Hill's, and examined her leg, and was very much delighted. This lady has since continued well.

Letter from Mrs. Munt to Dr. Beddoes.

Store-street, Sept. 1, 1795.

Sir,

I was about eighteen years distressed with a dreadful humour covering the whole of the lower part of the left leg. It arose from water first in that part, and a tendency to the dropsy. I was four years under Surgeon Pott, twenty-seven months under Sharp, nine months under Blick, twenty-seven months under Wade, and for some time under other eminent surgeons, but the humour continued as before. Previous to my attendance on Dr. Thornton and Mr. Hill, I was very bad indeed, in great pain and not able to walk fifty yards. After a fortnight from inhaling the *vital air*, I felt a most intolerable itching in the leg, and soon after the humour scurfed away, and the leg was healed. It is now eleven months since my cure, and I have felt no pain whatever, nor has even a pimple appeared on the part; and as before I could not walk an hundred yards, now nothing impedes my walking but my corpulency, which probably arose from my former long confinement.

I am, Sir, &c.

ELIZ. MUNT.

Observations on this Case by Dr. Thornton.

1. In fat people I have observed the *super-oxygenated air* usually creates some disturbance in the stomach. This at first surprised me; but did not the super-oxygenated blood feed upon the elements of fat, and thereby prevent the supply of food from the stomach, and that organ being robbed in some measure of its office, might it not at first feel the want of its customary action?

2. Fat people, I observe, are longer in consuming a given portion of air than others; hence perhaps they become liable to diseases, dependant on, or accompanied with, a want of oxygen in the blood.

3. In the present case strong occasional evacuations were employed. In the intervals, bark with the tincture of the same, and myrrh, were given to strengthen the fibres and promote the consent which exists between the stomach and the lungs.

4. The average dose of air employed, was thirty quarts of atmospheric air, *super-oxygenated* with two and sometimes three quarts of *vital air.*

Case 53.—*Mrs. Wilkinson, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page* 139.—*Communicated by Dr. Thornton.*

Mrs. Wilkinson, who lives in Dartmouth-street, Westminster, had for fourteen years a scorbutic humour in the legs, corroding into sores the muscular parts, which scurfed, and occasioned frequent and violent pains, and an almost incapacity for exercise. The muscles of the calf were hard, and of the colour of mahogany. A great variety of remedies had been tried, as water-dock, elm bark, sulphur, &c. and this lady by the advice of Dr. Haighton, physician to the Eastern Dispensary, had taken for the last four months bark and lime water. As Dr. Haighton thought her disease depended wholly upon the constitution, and there was no need of any local application different from what Mrs. Wilkinson was in the daily habit of applying, I was happy to add upon this occasion the *vital air*. This lady after inhaling a week, felt violent itching and pain in the legs; the colour of the parts was visibly improved; and the ulcers exhibited marks of active inflammation. In a few days after this, the acrid wounds which were ten in number, instead of a thin acrid discharge, threw out pus, and the edges were diminished. The hardened muscles not long after became soft. The other beneficial effects of the *vital air*, as far as regards appetite, spirits, warmth, sleep, &c. were the same as those which are so energetically described by the Rev. Mr. Atwood, in his invaluable Journal. In six weeks only Mrs. Wilkinson could use the flesh brush to both legs; and the last account I have of this lady is, that she was able to walk from Ramsgate to Margate, five miles, without a sense of pain in the legs, or even fatigue. I shall hope to send, at some future time, the sequel of this interesting case; and shall beg leave now to observe, that the leg of Patterson, which had for two years fifteen or twenty holes in it, which were healed by the inhalation of a *super-oxygenated air*, has continued perfectly sound, it is now above eighteen months; which leads me to the hope, that a permanent benefit will be also derived to this lady.

R. J. THORNTON.

Letter from Mr. Wilkinson to Dr. Thornton.

Dartmouth-street, Sept. 7, 1797.

Dear Sir,

Although you have never once asked my opinion respecting the effect your *air* has had on my wife, I think it but justice publicly to declare, that during the course of fourteen years my wife has never enjoyed such a state of health as since she has inhaled the factitious *air*. She has in that course of time applied to several medical men of great ability, but without any good effect. She had not inhaled the *air* more than three times, before I perceived a very visible difference in her countenance, in her spirits, in her appetite. The ulcers in her leg gradually dried up, and have never appeared since; it is now a twelvemonth. She is now ten years younger, at least, in constitution. In short, whatever Prejudice may say, I am sure that under God, the *oxygen air* has been the sole means of her recovery; and that there is not any one thing in nature besides that the cure can possibly be attributed to. I most sincerely thank you, Sir, for your kind attention to her, and I do sincerely believe if mankind at large were as sensible of the good effects of the *air* as I am, when properly and judiciously administered, you would need a host of agents to assist you in this grand and benevolent undertaking.

I am, dear Sir,

Wishing you every success your merits deserve,

Very sincerely your's,

J. Wilkinson.

Case 54.—*Mr. M'Kennon, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XIX. page* 291.—*Communicated by Dr. Thornton.*

Mr. Roderick M'Kennon, aged 67, went in the year 1758 as assistant apothecary to St. George's Hospital, where he had his washing, board, and lodging found him, with a suitable salary. In June, 1795, whilst in this employ, he went to see Dr. M'Nab, who then resided in Great Suffolk-street; and as he was at the door, a bitch in the house, which had puppies, furiously bit him near the calf of the leg, making a deep lacerated wound. The wound soon after became dreadfully inflamed, poultices were applied, but it was near a fortnight before he made his case known to the surgeons of the hospital. He was now confined to his room; and Mr. Home, a most experienced and eminent practitioner, continued his humane attentions to him above a twelvemonth, trying a variety of different applications, until, finding his case baffle all his endeavours, he was dismissed his employ, and left the hospital as incurable. Added to this dreadful and unforeseen affliction, he had an asthma, which had existed on him above ten years, which obliged him frequently to sit up the greatest part of the night with the windows wide open to procure breath. He was now in the vale of years, and with a gloomy prospect before him; for no salary was allowed this almost superannuated servant of a public charity, to which he had been attached above thirty years; and he had a wife and daughter to provide for. After quitting the hospital, Mr. Carpue, a surgeon, no less distinguished for zeal than abilities, for some months attended him; but finding all his endeavours ineffectual, he reluctantly took his leave of him as incurable. Such was the deplorable state of this unfortunate sufferer, when Mr. Carpue recommended him for trial with the *oxygen air*, using these very expressions: "Poor Roderick has been under Mr. Home's care," (an eminent surgeon, brother-in-law to John Hunter), "in St. George's Hospital, which he left as incurable, and since under my care for several months; and so bad is his case, that I am sure if you can cure him, you can cure the devil." Being no surgeon, I could have no wish to accept of such a case but for the cause of humanity and the sake of science; and I feel extreme delight in saying, that poor Roderick is now perfectly cured, the ulcer is healed, his asthma gone; and, in order that the philosophic world may see fuller particulars respecting this extraordinary cure, I am happy to be able to add the following testimonies:

A Letter to Dr. Thornton from Mr. Carpue, Surgeon at the York-Hospital, and Lecturer on Anatomy.

DEAR SIR,

I have seen Mr. M'Kennon, and have examined his leg, and think the cure you have wrought on it is indeed very astonishing. When he first came under my care, he laboured under an immense ulceration, extending from the external ancle of the right leg, which reached as high as the junction of the tendons of the gastrocnemii and solæus muscles. At this period the tendons of the peronæal muscles had sluffed, and in consequence I applied charcoal, which produced very considerable good; but upon mentioning this to a friend, who knew the case well*, he said, " It was immaterial what remedy I used, for it was a case in which he was certain *nothing* would prove *effectual*." After this I applied the diluted nitrous acid, and seemingly with advantage; but being obliged to go into the country, I left him under the care of another surgeon; and when I saw him, after an absence of six weeks, I found the sore in a very unfavourable condition; and for four months I used different applications, but to no purpose, and I conceived the case now to be perfectly incurable, and as such mentioned it to you when I had the pleasure of meeting you at Mr. Heaviside's: and I then proposed him to you for the trial of the *oxygen air*, as his case, if successful, would prove most decidedly its efficacy: for, in the multitude of sore legs I have attended, I must acknowledge I never saw a worse case, old West-India sores excepted.

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* Dr. Bailey, physician to St. George's Hospital.

I have the honor to be, Sir,
Your obedient servant,
J. C. CARPUE.

Having referred Mr. M'Kennon to Mr. Spencer, a surgeon in Charlotte-street, Fitzroy-square, for examination, I received the following letter:

A letter to Dr. Thornton from Mr. Spencer.

SIR,

I here enclose the treatment and the progressive cure of the ulcer which occupied the external ancle of the right leg of Mr. M'Kennon. For six weeks, by your direction, he daily took a gallon of *oxygen air*, mixed with four times that quantity of atmospheric air. The ulcer discharged properly, but seemed to heal very slowly: in consequence I gave him a double dose, and after a fortnight it produced very feverish symptoms, when he took, by your order, some purgatives, and then he resumed his usual dose of *super-oxygenated air* daily, until the ulcer diminishing by degrees, was at last completely healed, there being no discharge, the whole cicatrising, and the new formed surface looking extremely healthy. During this period no particular application or dressings were made use of by me, nor any medicine directed by you, but what before he said he had taken gallons of; so that I attribute his extraordinary cure entirely to the efficacy of the *oxygen air*. Happy in being able to give my testimony to so remarkable a case, I have the honor to be, dear Sir,

With the profoundest respect,
Your obedient humble servant,
T. Spencer.

Remarks by Dr. Thornton.

As Mr. M'Kennon took bark, some of the faculty may not be willing to give to the *oxygen air* the merit in this cure; I will therefore endeavour to state shortly my reasons for attributing every thing to this new remedy.

1. The operation of bark had been before tried; he had taken, he said, gallons of it.

2. When I first saw him, the sore, and muscles surrounding it, were wholly insensible; he did not feel a needle piercing them, nor could he perceive even the corrosive operation of caustic.

3. After inhaling the *vital air* but a few days, sensibility was restored, as Mr. Carpue, and others, witnessed.

4. Having cleansed the wound, it would remain dry for hours; but even whilst inhaling the *vital air*, the whole surface was immediately covered with a fine dew, as Dr. Monro and others witnessed.

5. To shew the progress of amendment whilst inhaling the *super-oxygenated air*, I am happy to be able to lay before the philosophic world the following testimony of an impartial observer, Mr. Douglas, of Baliol-College, Oxford:

" Towards the middle of March, 1798, I first saw Mr. M'Kennon. He had then a large and very foul ulcer, extending some inches above the right ancle. From that time to the present (April 30) I have repeatedly seen him, and each time could not possibly fail to be sensible of a most manifest improvement. At present the ulcer is diminished at least one-half in size since I first saw him;

the edges have a fine healthy appearance, and its general surface is astonishingly altered for the better."

6. When the *oxygen air* was left off, the sore remained stationary, and visibly improved when he again resumed it.

7. My strongest argument, however, is the success in this and in other cases equally desperate.

Mrs. Munt had been before cured of a sore leg of eighteen years' standing.

Mr. Atwood was cured of a sore leg of two years. When I asked Mr. Cruikshank whether it was true he had condemned the leg? he answered, with his usual emphasis, " I not only condemned his, but his life; for he was of so washy a constitution that he could not have lost the one without the other."

Next, the cure of Patterson. When I sent him to shew his leg to Mr. Cruikshank, which still possesses the marks of numerous ulcers, seeing varicose veins, this experienced surgeon said: " Tell Dr. Thornton that he is mistaken if he supposes he has made a permanent cure; for varicose ulcers were never cured without an operation, which, if he wishes, I will perform." The man, frightened at first, and then astonished, replied: " Sir, I have been cured perfectly now these two years." " That alters the case," answers this distinguished anatomist; " then tell Dr. Thornton that he has performed a most remarkable cure." Patterson still continues well; nor does there seem the smallest cause to suspect a relapse.

The cure of Mrs. Wilkinson, who had a sore leg fourteen years, is not less extraordinary. In this case I observed a peculiar phenomenon, alone explicable by the operation of the *oxygen air*. The fingers of both hands at their ends looked very red, as red as raw meat, were swollen, and felt very painful. The same was mentioned to me in private conversation by Dr. Beddoes in a patient of his, who, finding an asthma relieved by a small dose of *vital air*, took as much as he could at one time, produced a fever, when this same phenomenon I have just mentioned above occurred.

This leads me to repeat an observation I have again to express, that *oxygen air* promises to be an useful remedy in sore legs; for why have we not sore arms? The nearness of this part to the heart seems to be the only philosophic reason; and therefore a direct powerful stimulus to the heart, as *oxygen air*, promises the most certain good, aided by the invigorating effects of bark, steel, and other tonic medicines; not but that I would advise, where it can be properly done, as in hospitals, trials to be made with the *vital air* without medicine, to prevent all cavil; although it is undoubtedly unimportant to the sufferer by what means he is treated, so that he is but cured; and, until the contrary is proved, I shall ever think, that medicines, judiciously employed, certainly cannot impede the operation of *oxygen*, but may assist it.

Case 55.—*Mrs. Frith, under Dr. Thornton, cured. Vide Philosophical Magazine, No. X. page* 213.—*Communicated by Dr. Thornton.*

Mrs. Frith, æt. 45, wife of the Rev. William Frith, rector of Kentish Town, for nearly four years experienced the most violent pain in the neighbourhood of the heel, which she could compare to nothing but the burning of a caustic. Various outward applications had been made, and medicines taken internally, without any alleviation. When Mr. Cruikshank, lecturer on anatomy in the school of Dr. Hunter, called me in to a consultation, there was extended over the heel a wound about the size of a crown, very dark, the edges livid; and the fœtor from it was so intolerable, that, when her maid had occasion to remove the dressings, she had always volatiles applied to the nostrils to prevent her from fainting. The countenance shewed a livid paleness, the pulse was quick and tremulous, and the slightest exertion produced faintings. The bark, opium, and wine, were continued. This lady inhaled also six quarts of *vital air* mixed with twelve of atmospheric, and in a few days, as this respectable family can also testify, the livid hue of the wound disappeared, it had a more healthy appearance, and the discharge was so greatly improved, and fœtor gone, that when the smelling-bottle was presented to the servant, she said that there was not the least occasion for it. In a fortnight the sore was completely healed, the appetite restored, and countenance so greatly improved, that every friend marked the sudden alteration; the violence of the internal pain lessened by degrees, and the *super-oxygenated air* being continued for a few weeks longer, it altogether subsided; and this lady, for these last six months, has enjoyed uninterrupted health, and is able, at pleasure, to walk up Highgate-hill.

As many persons might wish to see the lady's journal in her own words, I here subjoin it, with a few observations.

"September 13, 1798. First inhaled the *vital air*. Felt acute spasms in the chest, and fainted."

Observation. Artificial inhalation is accompanied with increased action of the intercostal muscles, and gives frequently afterwards a sensation of muscular pain, which speedily goes off, and after a few trials does not appear again. The second effect we always see in those very weak, and hence the expression of "*being overpowered by the air.*" Patients labouring under scurvy, if suddenly exposed to a clear air, are killed instantaneously.

" September 15. Felt a most pleasant glow after the inhalation of the *vital air*. Spirits also much increased, feeling as if a great weight, or oppression, was removed.

" September 16. The hardness about the heel gone, as also the fœtor. Has less discharge. The wound looks redder. The glow, after the inhalation of the *vital air*, lasts for about a quarter of an hour.

" Sept. 18. The glow, and spirits, after this inhalation, lasted four hours. Feel wonderfully light and pleasant.

" September 20. Asked by my apothecary, " Whether I did not feel from the inhalation of the *vital air*, an uncomfortable heat?" My answer was, " that it produced the most pleasant glow imaginable, not at all resembling heat."

Observation. Putting the thermometer under my tongue, the heat was not increased. This effect may perhaps be accounted for from the increased sensibility of the nerves; or does the insensible perspiration raised by the capillaries of the skin being filled with the greater energy of the heart, account for this phenomenon better? I have almost invariably found the inside of the palm of the hand, after and during the inhalation, break out in a pleasant moisture, which are parts somewhat remote from the heart.

" October 4. The pain in the heel infinitely more lively. The pain is a new pain; but, thanks be to God! it remits for three or four hours every day."

These are the chief particulars: the plan of your Magazine may not admit of a further detail, nor does the nature of the case seem to require it.

General observation. The change of colour in the wound, so immediately after the inhalation of the *vital air*, seems to indicate a remarkable change wrought in the blood. It is not, however, the temporary increase of *oxygen* only in the system, that this partial inhalation produces; for it renders the blood also more attractive of this principle. Hence the continuance, for some time, even in London, among people of fashion, of the good looks acquired in the country; hence the pallid countenance of the man lately recovered from suffocation, or drowning; and hence, also, the return of the breath in patients under this treatment being more and more noxious, from a greater absorption of *oxygen*. The deterioration of the air inspired, has ever indicated the attractive power of the blood. Hence, also, it is that substances abounding in hydrogen are called cordials, from their sympathetic action on the heart, through the medium of the blood; but in the *super-oxygenated air* we have a more direct action on the heart, without exhausting the irritable principle, and occasioning indirect debility; and I trust I shall be able to make it evident to the unprejudiced mind, that this is a great desideratum in surgery and medicine, more especially where diseases are remote from the heart; or else, why do we so frequently hear of sore legs, but never of sore arms?

XXVI. ATONIC GOUT.

Case 56.—*Augustus Ernest, under Dr. Thornton, cured. Vide Number XXI. of the Philosophical Magazine. Communicated by Dr. Loane.*

Augustus Ernest, Esq. in the beginning of August, 1799, was seized with symptoms of asthma, great wheezing, and difficulty of breathing, cough, mucous expectoration, and incapacity of lying in an horizontal posture. Hence arose much swelling of the lower extremities. Different medicines were tried without effect, when Lord Egremont urged him to make trial of the *oxygen air* under Dr. Thornton, September 20. This remedy was accordingly had recourse to, and after inhaling the *vital air* but a few days, so much benefit was derived, that the patient was enabled to lie composed in bed during the whole of the night, and after a fortnight so great was the energy produced, that the gout made its appearance in the great toe of the left leg. The asthma, from this period, quitted Mr. Ernest, and the inflammation continued for the space of ten days in the toe and parts adjacent, and the subsequent swelling gradually subsiding, the patient was restored to perfect health. He then went to Lord Egremont's, previous to which I received the following satisfactory letter.

Letter to Dr. Loane.

November 9, 1799.
Warwick-street, Golden-square, No. 7.

DEAR SIR,

I am just going into Sussex to breathe there some of the pure atmospherical air; but I cannot leave this metropolis without reiterating to you and Dr. Thornton, with the tenderest feelings of gratitude, the warmest acknowledgments for the great benefit you have conferred on me, by administering to me the *vital air*; indeed, when I compare the situation in which I was, at the end of September, when I, as a dying man, came under both your cares, to what, thank God, you have brought me now; it seems to me quite miraculous, and I shall always look with astonishment at the wonderful discovery which has been made of the salutary virtues of the *oxygen air.*

I am, with sincere regard,
Ever faithfully, your's,
AUGUSTUS ERNEST.

When Mr. Ernest returned to London, his friends, Lord Romney, Count Bruhl, &c. congratulated him on his recovery; but his asthma soon after made him a second visit, and the *vital air* was again resumed, when in a few days it brought about another attack of gout in both feet, which went off kindly, leaving the patient in excellent health and extraordinary spirits.

It may be proper to mention the average dose of *vital air* daily given was six quarts, mixed with twelve of atmospheric air, and this was conjoined with the medicines most commonly given in such cases.

Case 57.—*Atonia, or Decay of the System. Vide Philosophical Magazine, No. IX. page* 30.

Mr. Mortlock, china-manufacturer, Oxford-road, near Park-street, was nearly a twelvemonth in that state of complete nervous debility, that he was unable to walk even across the room, and had been under the most experienced physicians without relief. By inhaling the *vital air*, two quarts, mixed with eighteen of atmospheric air, aided by tonic medicines, he was perfectly restored in a fortnight, and able to walk upwards of three miles without experiencing fatigue.

As the reader advances in this Work, he will see the system upon which the conduct of the *pneumatic* practitioners was conducted, and perhaps may be induced with them to think, that multiplying the tonic actions in asthenic diseases by as great variety of means as possible, is the most philosophical mode of practice; and the facts adduced* are a sufficient evidence of its utility.

---

* These are related in the order they occurred, without any selection.

CASES WHERE AZOTIC AIR, HYDROGEN, HYDRO-AZOT, AND FIXED AIR, HAVE BEEN EMPLOYED.

XXVII. THE CROUP.

Case 58.—*Mary Tovey, under Dr. Thornton, cured. Vide Mr. Townsend's Guide, Vol. I. page* 103.

Mrs. Tovey, of Charles-street, Tottenham-court Road, having lost one child in this sonorous and terrific disorder, anxiously brought her only remaining boy to Dr. Thornton for his advice. He immediately made the child inhale the azotic air with a proportion of common air, and the father and mother were surprised, when they observed that the hands, which were before " parching hot," soon felt " cold" to the touch; the pulse was rendered 20 beats less in a minute; the child no longer coughed as through a brazen trumpet, the fever seemed smothered, and the formation of the fatal membrane was prevented.

Six quarts of azotic air were inhaled, made by gradually burning of spirits of wine under a bell-glass.

XXVIII. PNEUMONIA.

Case 59.—*Mr. Crump, under Dr. Beddoes, cured. Vide Beddoes' Considerations, Part I. page* 175.—*Communicated by Dr. Beddoes.*

In the inflammatory stage of catarrh, and all the gradations of disease which connect a common cold with pleurisy, I hope the exhibition of a lowered atmosphere will prove an effectual remedy. From several cases I am at present inclined to prefer hydrogen or azotic air, because they can be so freely and frequently administered. In my letter to Dr. Darwin, I have described the effect of atmospheric air lowered with one-eighth of hydrogen air, and respired for a quarter of an hour, in an inflammation of the chest. The acute pain entirely subsided while the patient was breathing this mixture, and the febrile symptoms disappeared.—I have been eye-witness of another fact of the same kind since.

XXIX. PHTHISIS.

Case 60.—*Lieut. ——, under Dr. Beddoes, cured. Vide Dr. Beddoes' Considerations, Part IV. page* 114.—*Letter from Mr. Scott to Dr. Beddoes.*

Bombay, May 4, 1796.

SIR,

I have lately met with a case which is a confirmation of your opinion regarding the phthisis pulmonalis, and its method of cure. A lieutenant in the Bombay marine was lately, at Bengal, so ill of a complaint which every body believed to be a consumption, that for a long time he was incapable of doing his duty, and given over as incurable. In this hopeless situation it became necessary to him to proceed to Bombay. During the passage the bilge water of the ship got at some sugar with which she was laden; which, from its decomposition, was supposed to have injured very much the purity of the air. Below decks the air certainly became very impure; which at first induced this gentleman to remain above: but he one day, on going down below, observed that his respiration went on much more easily than on deck. He soon fell into a sound sleep in this new situation; and from that time he remained below in this atmosphere, from which he continued to feel relief. His health afterwards daily improved; and he is at this moment in good health, and doing his duty at sea.

I remain, Sir, &c.

W. SCOTT.

Case 61.—*Mr. Gregory, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XIII. page* 95.—*Communicated by Dr. Thornton.*

Mr. Gregory, M. P. of Berners-street, who had been long resident in India, laboured for several months under all the symptoms of phthisis pulmonalis. He expectorated a quantity of thick, opaque, and yellowish matter, which sunk in water; had disturbed nights, was greatly wasted, and his breathing was short and interrupted. He took by my order (which was executed by Mr. Seaton, a very ingenious apothecary and able chemist, who lives in Bridge-street, Westminster) from four to six quarts of hydro-azot daily, mixed with twelve of atmospheric air, and at the same time had a mixture of myrrh and bark, with opiates occasionally; and under this treatment the cough was soon diminished, and in six weeks the patient was restored to health, and has continued free from every complaint these eight months; even a cold now passes off without exciting any symptoms of alarm.

Observations by Dr. Thornton.

The hydro-azot is made by burning æther under a tin bell, when the oxygen unites with the hydrogen and forms water, and the residue is azotic air; a species of heavy, inflammable, or hydrogen air, and some æther in the state of vapour, and a small proportion of fixed air. I have myself inhaled ten quarts of this pure, and the pulse has sunk from eighty to seventy beats in a minute, and continued so for a quarter of an hour or more. It is very grateful to the lungs; and I flatter myself, that this new species of air, first employed by me, may prove hereafter a valuable acquisition to the *ars medendi.* As we brace the constitution with tonic medicines, there is danger of local inflammation, which this appears to obviate; or, has the hydro-azot any peculiar healing quality?

Case 62.—*J. Hughes, cured, by Dr. Thornton. Vide Philosophical Magazine, Vol. XXII. p.* 25.

John Hughes, æt. 18, helper to Mr. Cozens, livery-stable keeper, City Arms, London-street, had all the marked symptoms of a decline. He had a very bad cough; used in 24 hours to spit up near half a pint of discoloured matter; had colliquative sweats; hectic fever: great debility: appetite good, and yet reduced in flesh to a mere shadow. These strong criterions of consumption had been progressively increasing for more than half a year, when he applied to me for advice. I pursued in this case the same plan as had saved Mr. Gregory, of Berners-street, viz. the inhalation of *hydro-azotic gas*, with tonic medicines; and in two months all these alarming symptoms vanished, and the lad was restored to health.

Observations on this Case by Dr. Thornton.

1. Consumption is deemed a fatal disease; and the practice universally pursued in England has rendered it, I believe, still more destructive.

2. In Dr. Rush's works, the able professor of Medicine in Philadelphia, the best plan of treatment is laid down.

3. Bark (at which our practitioners are so alarmed) is recommended, with other tonic medicines.

4. Consumption must be considered either as a defluxion of the lungs, or as an abscess, or ulceration thereof.

5. If a defluxion, as in other gleets, bark is adviseable: if ulceration, the treatment of the constitution should be as in other wounds.—Bark is there universally recommended.

6. Dr. Rush has recorded some cases where persons shot

through the lungs have recovered. Captain Christie, of Liverpool, lately applied to me for advice. In a sharp engagement with the French, a ball entered the sternum, and lodged under the scapula. The wound in the lungs healed, and he felt afterwards only debility from the great loss of blood sustained.

7. The objection against bark, myrrh, and wine, is the *cough*. Colds are, I confess, aggravated by such treatment, and the incipient stage of phthisis; but in the subsequent stages the only chance is, I speak from wide experience, the practice I have here recommended.

8. Inflammation of the lungs is prevented by the hydro-azotic gas.

The lad is now before me; is fat, looks well, and has been cured a twelvemonth.

Case 63.—*Herpes, cured under Mr. Varley. Vide Philosophical Magazine, Vol. XXIII. p.* 68.—*Letter from Mr. Wilson, sadler, to Dr. Thornton.*

Sir, Oxford-street, October 20, 1805.

Having experienced the most striking good effects, I might say wonderful, from the *pneumatic* practice, I am delighted to make the same as publicly known as possible. For twenty-five years I was miserably afflicted with herpes from the crown of my head to the sole of my foot, and had employed Dr. Carmichael Smith, and other gentlemen of the faculty; but my terrible affliction baffled all their skill. I therefore applied to Mr. Varley, and he recommended the trial of the *carbonic acid air*, confined by means of oil-skin, over the parts affected, an hour each day; and such were the astonishing salutary effects of the air, that in the course of two months this universal disease was removed. It is now above seven years ago, and I have never felt any return since, but enjoy a most comfortable state of health.

I have the honour to be, Sir,
Your faithful obedient servant,
MATTHEW WILSON.

Observations on this Case by Dr. Thornton.

1. The herpes is a species of hitherto incurable leprosy, and was confirmed in the habit of this gentleman, having existed, as he writes to me, twenty-five years.

2. The common means failing, the trial of *carbonic acid air* to the parts affected was a judicious application.

3. If meat is put into fixed air it does not become putrid, and even tainted meat becomes sweet by immersion in fixed air.

4. Fixed air also takes off inflammation; for if a blister be cut, and fixed air be applied, the pain instantly ceases.

5. In this case it evidently promoted action, for after each application a moisture always prevailed; the incrustations were before hard and dry.

6. As the cure has existed seven years, a relapse is not to be dreaded; and this case is, I think, a very striking example of the propriety, not of the "madness," of the application of the *pneumatic* agents.

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